REPORT

ON THE

Traction Improvement and Development

WITHIN THE PROVIDENCE DISTRICT

TO THE

Joint Committee on Railroad Franchises

PROVIDENCE CITY COUNCIL

By

BION J. ARNOLD

CONSULTING ENGINEER

PROVIDENCE, RHODE ISLAND

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LETTER OF TRANSMITTAL.

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NEW YORK

Hon. George W. Smith, Chairman, and Members,
Joint Special Committee on Railroad Franchises,
Providence, City Council.

Sirs: Pursuant to the instructions conveyed in the joint resolutions of your Committee, dated January 7, 1911 and previous resolutions, appointing a special sub-committee on improvements and methods, I beg to submit my report on Surface Transportation in Providence.

This report has been prepared in sections, in order to permit of a convenient sub-division of the whole subject. According to my understanding of the desire of the Committee, the numerous topics of these sub-divisions have been discussed in detail with a view of presenting cogent reasons for the conclusions reached. It is thought that in this manner many of these conclusions will be evident, where otherwise they might not be clearly understood.

Preceding the body of the report will be found a summary of conclusions and recommendations, which is intended to briefly review the salient points of the report for the benefit of those who desire a comprehensive view of the subject without being required to study it in detail.

In this study I have not attempted to investigate the corporate relationships or finances of the Rhode Island Company, except in a general way from the records available, nor to develop the most equitable basis for taxing the corporation. My entire effort, on the other hand, has been to investigate the traction situation as it exists, trace its previous development, make recommendations for its physical improvement, and give some idea of the magnitude of the problem of the future.

I particularly desire to make acknowledgment of the courtesy and assistance of the officials of the Rhode Island Company who have spared no effort nor hesitated to furnish necessary information regarding its property.

Respectfully submitted,

Bion J. Arnold

Consulting Engineer.

Chicago, June 1, 1911.

MATTERS REQUIRING IMMEDIATE EXECUTION.

Some form of an East side approach.

An Exchange Place loop terminal.

Faster car and passenger movement and schedule speed.

Street widening and removal of obstructions.

Modification of Traffic Ordinance restrictions.

Re-routing in down-town loading district.

Electric switches at all important switching points.

Extensive double tracking within the City.

Increased rate of track extensions within the City.

Prepayment fare collections with lengthened platforms.

Increase in car mileage (December basis 17.2%).

Redistribution of service on outlying lines.

Improved car house facilities.

Installation of Broadway express service.

Introduction of convertible equipment with part cross seats.

Single-ended operation on loop lines of heavy traffic.

Trial of two-motor maximum traction truck equipment.

Curtailment of transfer abuse.

Reorganization of destination sign system.

Development of nearest suburbs—East side and outer Smith street.

MATTERS REQUIRING CO-OPERATION OF THE CITY.

Develop the nearest suburbs first.

Determine immediately upon some plan of East side approach.

Provide for a suitable Exchange Place loop.

Remove obstructions by easing off curbs at intersections, especially old short radius curbs, and by widening necessary streets.

Amend speed ordinance permitting street cars the same running speed, subject to suitable precautions within the loading district, as automobiles.

Vehicle traffic ordinance regulating size of vehicles; in necessarily large vehicles, regulating their use on certain narrow streets.

Right-of-way ordinance giving street cars a second right of way over all other vehicles except fire, police and ambulance vehicles.

Amend ordinance restrictions, permitting any reasonable design of car with platform overhang no greater than at present.

Encourage all reasonable track extensions, especially into outlying territory.

Provide shelters at loading and transfer points.

Resurvey for electrolysis after re-routing plans are put into effect.

Reorganize trolley freight terminal location.

Maintain record of traction operations as regards earnings, passengers, transfers, car mileage, maintenance, extensons, improvements, etc.

Authorize limited-stop suburban express service.

MATTERS REQUIRING CO-OPERATION OF THE PUBLIC.

Cultivate prompt movement so that both Public and Company may benefit.

Have exact fare ready if possible, before entering the car to facilitate a prepayment plan of fare collection.

Form the habit of moving forward in a car.

Investigate complaints and Company's rules before criticising.

Render complaints to Company first, newspapers second.

Assist in re-routing with arguments and data, based on knowledge rather than assumption.

Forego the convenience of a private stop in front of home or office, if necessary for the execution of effective re-routing plans.

Avoid round trip riding on a single fare by means of transfers.

Avoid boarding or leaving cars in motion.

PROGRAM FOR FUTURE EXECUTION.

Extensive City thoroughfare development.

Encouragement of suburban development by trackage extensions.

Cross-town transit development.

Separate routing of freights and expresses from locals.

Trolley freight terminal.

Transfer shelter stations.

Additional car houses.

High tension transmission with sub-stations.

Suburban electrification plans for steam lines.

Comprehensive City development plan.

GENERAL SUMMARY OF CONCLUSIONS.

Synopsis: Brief summary of complete report. Present conditions affecting traction development. Some phases of transportation about Providence. Growth of the traction district. Rush hour traffic in the terminal loading district. Service requirements for present and future. Improvements in service. Improvements in equipment. City planning. Publicity and supervision. Rerouting and service redistribution.

PRESENT CONDITIONS.

The general thought that this report attempts primarily to convey to the citizens of Providence is one of optimism. In many respects the traction situation is more fortunate than in other cities, but especially so because the earning capacity of the property has been well developed and the special improvements desired may be put into effect without any wholesale uprooting of either the financial or operating structure of the Company. In other words, it is possible for the Company to inaugurate and maintain the higher standard of service herein outlined and still be certain to receive a good return on its actual investment. This is a fundamental condition in the absence of which improvements are difficult to carry out without imposing undeserved hardships upon investors in the property.

The present service rendered by the Rhode Island Company in Providence is not constitutionally bad; in some respects it

is better than in other cities, and the present deficiencies can be largely and almost immediately overcome by carrying out a co-operative program in which both City and Company must participate for effective results. Providence is a rapidly growing community, evidencing an unusually high civic standard. This standard is in danger of defeat by virtue of impediments and restrictions to healthy progress that are unworthy of the greater cause. A continued spirit of suspicion and antagonism between the Public and Corporation will only bear fruit in the form of delayed progress and continued inadequate service. While the general subject of franchise renewal is under consideration, therefore, a genuine effort should be made by all concerned to effect the best possible solution of the problem in hand, by friendly, orderly and continuous arbitration, not by punitive means.

The community has outgrown its present streets, and should create new or enlarged ones for double track operation. The down-town roadways especially are very cramped, and the citizens do not seem to properly appreciate the necessity of wider ones. Routing the majority of cars over a few main streets appears to have been unduly influenced by the pressure of private or business interests. The convergence of the radial arteries has only accentuated this difficulty. Street obstruction has discouraged fast schedule speed; slow running has invited sluggish passenger movement, and as a general result much extra equipment is entailed which tends to discourage liberal yearly additions to the rolling stock necessary for adequate service. The shortage of cars in December simply served to focus attention upon the cumulative result of these deficiencies.

Hostile public opinion renders it exceedingly difficult to inaugurate any radical public improvements in Providence that would tend to benefit the traction service, and by the same token it appears that the Company considers it useless to attempt any such improvement on its own account. Two essential improvements are a new loop terminal system at Exchange Place, as contemplated in previous years, and an adequate East side approach in the form of an open street, with an easier grade than now exists, or a tunnel. Ultra-conservatism in the execution of plans for an East side approach is largely responsible for the undeveloped condition of the East side. Thus far it has seemed impossible for the Public to agree upon any plan, however meritorious, and until a decision is reached, the College Hill difficulty cannot be readily alleviated, or the East side service materially improved.

Thorough re-routing in the terminal district is necessary to relieve congested streets as later outlined in detail. Routing, however, requires much time for execution and it is possible now only to outline a general scheme, based upon correct principles. The details of a final solution can only be settled by conference between City and Company representatives. Comprehensive re-routing involves the welfare of the Public in such a variety of ways that an acceptable plan can hardly be evolved by any one person or interest.

This will also involve intelligent city planning, which should not be entrusted to accidental development or snap-judgment, and the establishment of a plan affording the City definite protection against the ultimate usurpation of its concessions for corporate gain.

TRANSPORTATION.

The transportation problem of Providence and vicinity is one of a district, not a city, and any comprehensive plan should not disregard suburban development, but rather encourage it, especially the East side.

Here is at present the greatest opportunity for Providence—a large and desirable residential territory of fifty to sixty thousand people within the 1½ mile circle west of the Seekonk River and three miles east. The work of the East side Approach Commission is of the greatest importance at the present state of the City's development, and the consummation of its plans should not be hampered by superficial criticism.

The radial system of thoroughfares is fortunate in respect to maximum running time; the East Side is alone denied such facilities. Moreover, such a system requires cross-town lines connecting outlying business or residence centres. The absence of such provisions has brought about widespread abuse of transfers by round-trip riding.

The competition of steam railroads is of little importance, owing to infrequency of service. This presumably results from a single management for traction and railroad properties. In fact, the withdrawal of Olneyville steam service indicates a deliberate fostering of the traction lines.

The City should develop its nearest suburbs first. Increasing length of haul within the five cent fare zone on certain lines always means decreased service on other lines, resulting in still further erratic development.

Local co-operation in all plans for transit improvements is essential. The idea of a District Control, based upon adequate representation, should prevail.

Rapid Transit. Subways have been advocated as a means of relief for present congestion, both in the form of sub-surface trolley routes and subways operated independently of the trolley system. Neither of these systems are believed to be warranted, at least until far in the future. The loading district is located in a basin from which steep grades ascend in all directions, and exits at desirable junction points would only accentuate this difficulty. Ample relief may be secured by other means discussed elsewhere in detail. Providence has not begun to reach a sufficient density of population or traffic to yield adequate returns on the necessary investment in rapid transit subways.

GROWTH.

It is essential in determining adequate traction service to plan for present and future growth, not only of the district as a whole, but of its minor civil divisions and sub-centers. As considerable suburban traffic exists, the traction problem of Providence must also be studied as that of the Union R. R. Division corresponding practically to the 5 cent zone which usually extends to the city limits, but in certain cases well beyond, such as to Oaklawn, Centredale and E. Providence.

Providence has doubled its population every 20 to 25 years. It increased 27.5% in the last decade while its nearest neighbor, Boston, increased but 19.6%. With a steady growth since 1875 the City will probably approximate 300,000 people in 1925, the five cent fare zone 386,000 and the district tributary to Providence in a commercial way, 465,000 persons. The present distribution and recent growth within the City is

unusually uniform with the exception of Federal Hill, which averages 66.4 persons per acre, and the upper East side, 10.1, as against an average for the City of 19.25 persons per acre.

Realty valuation, now $190,000,000, has doubled in 25 years and is growing faster than the population. Bank clearings, the best index of prosperity, have increased over half in twelve years and now aggregate $415,000,000. That surface transportation is becoming more and more essential is evident from the fact that traction earnings in percentage of bank clearings have increased from 0.58 to 0.8% since 1898.

The Rhode Island Company. Trackage has increased steadily for the last decade 4.14 miles per year for the system, 3.13 for the Union Divisions, (which has a total trackage of 152.74) and 1.48 for the City of Providence. The City contains 72.4% of the trackage of the Union Division or 88.68 miles and receives proportionate income therefrom. This income has been increasing during the past ten years, but not in proportion since 1905.

The normal increase in passenger traffic and earnings for the entire system suffered but one pause in 1907-08, but during the past seven years has increased to a total of 82,790,000 fare passengers or 61.4%. The city riding has more than doubled in twelve years.

Car equipment increase has not kept pace with the growth and equipment is now about one and one-half years behind. From 1903 to 1907 traffic increased 43% and car equipment but 21%. Since 1907 no new equipment has been put into commission to meet this growth up to March, 1911. At that time there were 335 cars available on the Union Division for the winter service, with 331 cars called for by schedule, also 353 cars available for summer service.

The Rhode Island system, as a whole, earned about $9.70 per capita in 1910. The Union Division, $11.57, and the City of Providence, only $8.55. Assuming earnings per capita increasing as fast as the population, an increase of business over 80% must be provided for the next fifteen years; i.e., a total of about $6,000,000 earnings for the Union Division. This law of increase has been found reasonable for other cities and means that when the population doubles the gross earnings will be quadrupled. This, then, is the measure of the traction problem of Providence.

TRAFFIC IN THE TERMINAL DISTRICT.

The actual passenger movement outbound from the terminal loading district was determined by actual count, during March, at the maximum loading point of the nine outlet throats of travel. These counts show 14,730 passengers and 11,036 seats outbound during the typical rush hour, 5:30 to 6:30 P. M., an average loading of 133.5%, i.e., 33.5% represented standing load. NB 153%

During the heaviest ten minute period nearly one-quarter of the traffic occurred equivalent to a rate of 22,450 passengers per hour. For the heaviest twenty minute interval the loading varied from 89% to 164% at individual throats or 123.6% to 141% for the system.

During the hour, about one car per minute on the average passed Hoyle Square and Trinity Square. However, a maximum car interval of 6½ minutes on Broad street and 8¾ minutes at College Hill indicated considerable irregularity in running, no doubt partly due to down-town congestion, but

also to inadequate dispatching and inspection. Other counts also exhibit this irregularity which occurs not only at the throats as a whole, but also on individual routes.

The Company operates double service over the Union Division during rush hours, and on some of the routes three times the service of non-rush hours, and endeavors to maintain, where equipment is available, a standard for individual car loading of about 165%, with the exception of the thirty-four seat class, for which the standard is too high, viz., 200%.

Monthly records elsewhere discussed show that the traffic during February and March is the minimum of the year, and that the traffic averages 15.6% higher during the year than in March, December 13.6% and July 38.3% higher. The summer maximum, however, is not entirely coincident with the rush hour.

This means that the service rendered, as shown by the above counts, was presumably much better than during mid-winter conditions.

SERVICE REQUIREMENTS.

Adequate service implies the just proportioning of service to income. Approximately 70% of the income is necessary to operate and provide for taxes and an adequate depreciation fund. Since 1907 this operating ratio has been steadily decreasing on the entire Rhode Island system. For the Union Division the traffic during the past four years increased 6.75%, while the car mileage decreased 1.1% with approximately the same equipment. To equalize this growth an increase in

service of 1,622,300 car miles or 17.2% should have been made in 1910 and distributed over the various lines of the division.

With decreased car mileage the earnings per car mile have increased to an excessive degree; likewise the total number of passengers per car mile carried. In Providence, essentially a short haul city, these earnings would presumably be higher than in a long haul city, but they should hardly exceed 30c. per car mile with present equipment.

The track mileage has not increased at the necessary rate of about 3.6 miles per year to keep pace with the population. Since 1901 the rate has averaged 2.5 miles per year. This accounts for the lack of much double tracking needed throughout the system. The average population per mile of route for the city is nearly 3,000, but the maximum is as high as 13,700 along Atwells-Academy avenues.

The average loading shown by the March counts 133.5% is not an unreasonable standard for rush hour conditions in Providence, and may be taken as a basis for service estimates. With the increase necessary for the traffic of last December 12,600 seats per hour were required to handle 16,740 passengers per hour. This means that the present winter schedule should have been increased 13.4% to give as good service in December as occurred in March.

Cars. In order to fulfill this standard the rate of car flow through the loading district during December should have been 362 cars per hour of the present type. The present winter schedule calls for 331 cars to be actually in service on the lines of the Union Division, but on this basis of December traffic 375 cars of the present type were required for adequate service.

Here it must be stated clearly that any increase in schedule speed as contemplated in this report will result in a proportionate increase in car mileage for the same equipment, or vice versa, less equipment for the same service. It is, therefore, but just that the Company should have been permitted to avail itself of such an increase and had this been the case it is possible that adequate service might have been furnished with the present equipment by means of proportionately faster schedules. For the future, additional equipment will be required at the maximum rate of 20 cars per year to provide only for normal growth and more will be required for retiring obsolete and worn out cars. The Company actually increased its equipment at the rate of 50 cars per year from 1901 to 1907, of which about 43 cars should have been assigned to the Union Division.

SERVICE IMPROVEMENTS.

The most important improvement in service immediately needed is an increase in schedule speed, which averages only 7.96 miles per hour; entirely too low in a city of radial thoroughfares. Some of the lines average little more than six miles per hour and in actual running, below this. Other lines, where reasonably free running is possible, make better time—nine miles per hour. By city ordinance the speed of cars is limited, for the greater part of the city, outside of the business district, to nine miles per hour. Automobiles are permitted fifteen miles per hour. This limitation upon cars is unjust and in fact, even the present slow schedule could not be made without infraction of the rules, for 15 to 30% of the time is

required for stops and perhaps 50% of the remainder for acceleration and braking. Railway transportation should not only be given the preference of right of way over vehicles, but the same rules for maximum speed should apply. For the same element of danger involved, cars operating upon a fixed track with air brakes and fenders could obviously operate at least as fast as undirected vehicles.

Suburban development practically dictates the necessity of limited stop expresses. If separate routes can be found for routing them outside of the congested local arteries of traffic, these should be largely reserved for this important service.

White posts indicating stopping points average within the settled districts of Providence approximately 250 feet apart or twenty stops per mile. These are entirely too frequent for making satisfactory running time. The spacing of 500 feet would be quite reasonable and would permit a stop at about every second street, which is sufficient.

Schedule delays now result from congestion in the loading district which is unavoidable, holdups at single track turnouts, counter-operation at intersections with main arteries, and from general lack of promptness in dispatching and running of cars throughout the system. More rigid inspection and discipline will remove the last objection and more double tracking, more frequent turnouts with closer regulation of signs and operation of vehicles the remainder, assuming, of course, the realization of contemplated plans for the relief of the downtown thoroughfares.

Electric switches should be installed at all important junction points, at least within the loading district, to save switching time.

Night service should be extended on all principal lines and emergency routing provided.

Crosstown lines will be required in the near future to connect various outlying communities of interest.

Transfer abuse, which is quite prevalent in Providence should be corrected by some selective method, possibly by sectioning the various districts of the city by means of colors. The present transfer privileges are liberal and the Company should be protected from this source of petty fraud, i. e., round trip riding for a single fare.

Express service to Olneyville is urgently required. It is believed that Broadway offers the best opportunity for such a service at present, looping at Exchange Place via Fountain and Washington streets. In the future the demand for an East Side-West Side electrification of the steam lines through Union Station will probably occur, giving direct service from South Providence and Olneyville to East Providence and the South shore.

Trolley freight should be absolutely excluded from important arteries during rush hours and separate routes reserved as far as possible for this service, having in mind the ultimate establishment of a central interurban freight terminal more suited to the needs of the city than the present one.

EQUIPMENT IMPROVEMENTS.

The present rolling stock operated is about equally divided between summer and winter types. Of the winter equipment about 28% of the total number represents small single truck cars, but this is only 21% of the seating capacity. These

small cars will be a necessity until a suitable East Side approach is determined upon, then they should be retired for larger equipment.

In all of the present cars the vestibules are entirely too small and constricted, although the thirty-four and forty-two seat class cars are otherwise of suitable proportions, and the latter of excellent design and construction. This narrow vestibule has been necessary on the largest cars to keep within the present ordinances limiting cars as to length and still give the required seating capacity of car body.

Prepayment. Modern practice unmistakably points to the acceptance of the prepayment type of car, which will necessitate longer platforms. Fortunately, the citizens of Providence are already educated to the essential prepayment principle, viz., direct automatic registration by the passenger. Contrary to the opinion of many patrons, this device prevents possible fraud of both conductor and passenger and secures to the latter the maximum possible service. Prepayment platforms separate incoming and outgoing passengers and thus load more quickly, the general movement being forward through the car. The conductor is stationed at the rear and collects fares on entering. In the type of car best suited to Providence conditions, bulkheads are omitted and the step raises automatically with the closing of the platform doors, thus preventing accident and facilitating rapid schedule speed.

By tapering platforms it is possible to increase the present length of platform from 5 feet to at least 6 feet 6 inches and the overhang of the platform bumper is thereby reduced to no greater than the present summer or winter cars. The city ordinances should, therefore, be amended to restrict overhang rather than length.

A seating arrangement in which at least half are cross seats should be adopted for the City cars and with all cross seats for long haul suburban cars.

Convertible Cars. Semi-convertible cars should be gradually put into service. While quite as comfortable as open bench cars, they will largely reduce accidents and avoid an unnecessary duplication of investment in rolling stock. Removal of the sides in warm weather creates practically a centre aisle open car.

Single ended operation is recommended for loop lines of heavy traffic. By removing the electrical and brake equipment from the rear platform much valuable loading space will be available. With this improvement the present Bradley cars and vestibules might possibly be used with the prepayment principle until they are worn out.

The present standard height of step of 14¼ inches is not unreasonable. The wider lift step of the prepayment platform will reduce the present objection of the steps being too steep, i. e., having insufficient landing space.

Electric signal bells should be installed on all cars and the lighting improved by replacing exhausted lamps. Head lights should be dimmed within the City limits.

Car Houses. The present standard of construction is adequate except that it does not provide for double ended car houses, enabling cars to enter and leave at opposite ends, being cleaned and inspected in transit. The older car houses should be remodelled or rebuilt entirely, and additional ones constructed in the North and East side in the near future.

The present standard of inspection, cleaning and repairs is reasonable if adhered to, but this cannot be without proper facilities.

Owing to the transmission distance necessary for the longer lines, excessive drop in voltage occurs on some of these lines. This can only be remedied without excessive investment in copper by outlaying sub-stations, which will be required as the system grows.

Tracks. Concrete sub-base tracks, now standard, is good practice and should be extended in all renewal work on trunk lines of heavy traffic. This standard, however, is not being adhered to during this season's work. Much double tracking is necessary to properly handle the traffic now existing, and track mileage should increase faster than the present rate. Electric switches should be installed immediately at the important switching points on trunk lines. Electrical semaphore signals for single track turn-outs are being tried out, and should be extended over the important lines if successful.

CITY PLANNING.

Without effective co-operation between the City and the Company the plans for traction improvements recommended in this report can be but of little avail. These improvements are so essential to orderly municipal development that the work should be properly executed by some technically constituted commission. This body should first study vehicle traffic in relation to street congestion to properly supplement the transit studies presented herein.

Street widening forms an essential step in any such plans, especially at Constitution Hill, and Randall, Steeple, Aborn, Snow or Mathewson and Smith streets. The double tracking of Smith street is necessary to the fuller development of the suburban territory along this important radial thoroughfare. Aborn street offers an effective outlet to the west side arteries —Broadway and Atwells avenue. The widening of Snow or Mathewson street is essential for transverse routing and undoubtedly presents serious problems. The North Main street lines urgently require the abolition of the counter travel and the congestion now occurring at Mill street.

An East Side approach is absolutely essential and alternatives are practically eliminated with the exception of the open grade street and the traction tunnel. The open grade street is preferable from many standpoints, principally on the score of need for such a thoroughfare for the proper development of such a large territory. It should extend from Post Office Square in preference to Market Square, as the least congested and most logical point available for the most effective routing.

City planning should be broadly constructed and not niggardly. It should not be needlessly hampered by tradition. Prevention is always cheaper than cure.

Conservation of City's Interests. The recommendations contained in this report for increased facilities to be made available to the railroad company raises the question—What is the City to receive in return for its activities and expenditures in making possible better transit and what assurance has the City that when all these improvements have been granted, the railway company will not take advantage of

them solely for its own benefit, and not for the benefit of its patrons at large? And if these improvements are incorporated in its franchise what assurance will the City have that, even though the present management is disposed to deal fairly with the City, some future management otherwise disposed should not seek to annul or jeopardize these concessions by failing to fulfill the conditions of service contemplated thereby?

Publicity. The answer to all of these questions is PUBLICITY. With the facts regarding its daily operation continually on record, no management, however adroit, could conceal a deliberate curtailment in service, providing the standards of such service were written into its franchise.

This result may be accomplished either by defining respectively the apportionment of earnings allotted to service and the return on investment, or by defining standards of service that may be determined from records and checked by counts. These records must be maintained through co-operation of City and Company. No reasonable management can object to an authorized record of its operations, provided these operations conceal no deliberate intent to extract greater returns out of the property than is warranted by its patronage.

Even if the most perfect plan of operation were evolved and incorporated in definite charter form, it must be borne in mind that service cannot be predicted accurately for all time to come. The riding habit is subject to such unaccountable variations as to require continuous and analytical study in order that the service shall be at all times reasonably adequate.

Publicity, simply by virtue of its existence, disarms unintelligent criticism, and maintaining a co-operative record by

City and Company will operate as an effective protection of the latter against attacks not founded on facts.

Supervision. But manifestly the personnel of such official organization authorized to keep such a record must be clear of political bias and of unquestionable professional integrity. Such work might be properly intrusted to a local engineer of ability and experience in railway lines.

Until such local supervision is established there is no assurance except the reputation and good faith of the railway management that the City will receive and continue to receive its just share in the results of the improvements it inaugurates. If a State Public Service Commission were in existence, clothed with effective powers of investigation and direction by specific order, such local authority would in no sense be necessary. The powers of the present Railroad Commissioner are so curtailed and inadequate to meet the situation that a local authority becomes necessary if a State Commission is not organized.

REROUTING AND SERVICE REDISTRIBUTION.

In working out the problem of rerouting it is very important that a plan be developed through orderly and friendly co-operation between City and Company representatives, and that improvements be discussed from time to time in the same manner.

Rerouting is a matter for arbitration rather than individual judgment. No "One Man" plan can ever be a success. The report attempts to develop methods of analysis that may be followed and to direct attention to improvements most needed,

based upon such limited observations as were possible within the short time available. A complete study should comprehend at least one year's seasonal changes.

Loading District. Relief of the down-town thoroughfares is based upon, first, a study of street capacities, and second, a redistribution of cars by routes. The general principles discussed are embodied in certain definite rerouting plans. One additional plan has been submitted by the Company. Any of the four plans is feasible and reduces the general rush hour congestion of streets from one-third to one-half, and considerably below the limit of street capacity, which the present routing plan exceeds in many cases. For the present speed limit, 6 miles per hour, not more than 80 to 90 cars per hour should pass along any track in the loading district. There are now 110 cars on Westminster street and 133 on Weybosset.

In general, cars should be routed as directly through the business district as possible without diversion until a street of suitable width is reached. Long haul suburbans should be looped back, where possible, just outside the center of the city, in order to save delay. Counter operation should be abolished and individual or double track provided whenever possible. A walk of one block is considered to be reasonably convenient service to any shopping district. The Friendship Street extension and Fenner and Claverick streets are required for the most effective routing of South Providence lines; and the Exchange Place loop and an East side approach are considered as essential parts of any improvement.

Outlying District. Recommendations are based upon passenger counts on individual routes, in connection with a

study of yearly, seasonal and monthly records of traffic and earnings by routes and of daily trip cards. While the problem, as a whole, involved a total increase of 1,622,000 car miles for the year 1910, an immediate solution can only be suggested along lines of trackage extension, decreased headway, short haul extras, limited expresses, etc., any changes in present schedules and routing will so modify the results that it is idle to specify improvements in minute detail. Earnings on most lines are high enough to justify these improvements. With the Company rests the responsibility for initiating the steps (and carrying out future studies) suggested herein.

Providence is a short haul city. The average ride is only 2.07 miles, which results in unusually high earning capacity. Rush hour loading in many cases is too heavy, especially on long haul routes, standing loads continuing for 4 to 5 miles. But a number of additional routes can be devised as short haul extras to reduce this. Lower limits of car capacity should, therefore, be imposed on long haul than on short haul loading and the extension of the limited stop express idea is recommended largely with this end in view. The greatest single factor in any improvement plan is increased speed and passenger movement, for by this means, the same results may be achieved without needless extra investment in equipment and operating expense resulting therefrom. The average interval observed between some 3,000 stops was over 500 feet, so that the spacing of white posts suggested will more than meet the needs of the average patron.

The establishment of through routes may be strongly commended. Most of the present ones are on a good paying basis and, from time to time other connections between short haul

lines should be devised to further relieve down-town congestion. Limited stop expresses for long haul patrons only, seem to be feasible under the present conditions. Much double tracking is necessary in order to properly handle the traffic and to avoid the serious delays at meeting points now encountered.

Finally, it must be recalled that this investigation concerns officially only the City of Providence. Although the studies necessarily embraced the entire traction district, recommendations were properly confined to the City for the reason that no form of co-operative District control is now in existence. However, in some instances, conditions outside the city limits have been treated, but it will be apparent that this report might be logically supplemented by further studies, by local officials of the suburban districts, and, especially, studies of the ensuing summer traffic which forms so important a part of suburban transportation.

Section I.

GENERAL ANALYSIS OF PRESENT CONDITIONS.

Synopsis: *Shortage of cars. Delayed car orders. Greater speed of car and passenger movement essential. Co-operation of City necessary. City streets outgrown. Realty values rising. Steam suburban service involved. Corporations on the defensive. Public distrust. Publicity of results and intentions desirable. Re-routing imperative. Construction program for City and Company needed.*

The present traffic investigation is the result of expiring franchises and a shortage in cars during the past winter, due to delayed deliveries from the builder; bad weather naturally aggravated the shortage difficulty. It appears from the records that practically no new cars have been added or put into service by the Rhode Island Company since the summer of 1907, and the order for fifty new Bradley cars, placed early in 1910, was intended to relieve the situation during the past winter. Owing to conditions at the car factory, outside of the control of the Rhode Island Company, according to its reports, deliveries were not commenced until 1911, and completed during the latter part of March, so that the Company was forced to handle its winter traffic with a total of 365 cars, including reserve, operating in or into Providence. At the present time it has 415 cars available, an increase in actual seating capacity of nearly 20%, including all old rolling stock that may be scheduled for withdrawal during the present

season. To a certain degree the cessation of car orders after 1907 was but logical owing to the questionable future presented by the depression of that year (Fig. 1.) and that the renewed growth of 1908 was again checked in 1909.

The excessive loading during December served to bring to the public notice the bad conditions prevalent sufficient to develop a hostile public feeling (and to accelerate the present investigation).

It appears clear that the Company has not kept fully abreast the demand for new equipment. From 1902 to 1910 inclusive, the revenue fares on the entire system increased 62%, while the car equipment increased only 22%. It is also true, however, that the conditions causing undue congestion within the loading district of the City are directly or indirectly responsible for a large share of the dissatisfaction expressed regarding the traction service. With the present limited trackage and extreme concentration of traffic along certain streets, adequate service can hardly be expected in Providence with any amount of equipment, for the reason that it is impossible to maintain a reasonable schedule speed and secure the proper mileage per car. The speed is further retarded within the City by the excessive number of stops. Absence of prepayment fare collection, short and constricted platforms, general absence of prompt movement on the part of both passengers and trainmen, constitute further retarding influences which should be improved. Much can be accomplished by prompt, rigid dispatching and inspection.

The most important factor in the present problem is increased speed of car movement through down-town districts and of passenger movement at all points. Rapid car move-

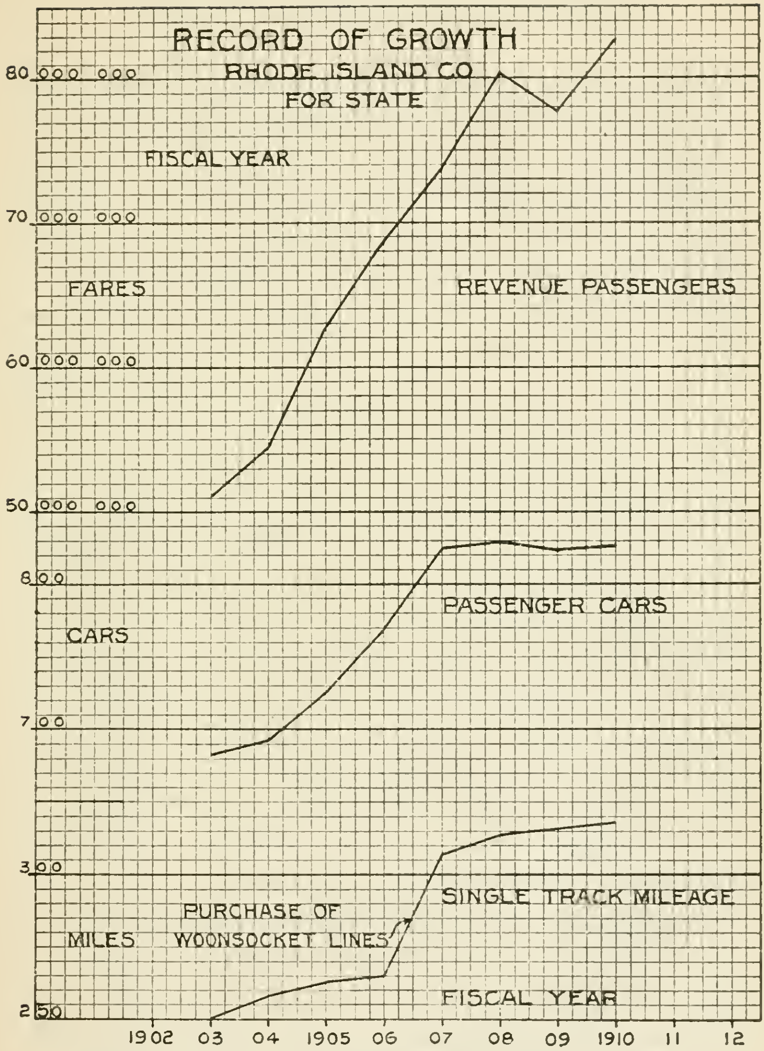

FIGURE 1—RECORD OF GROWTH, RHODE ISLAND COMPANY.

Representing the relative growth of passenger traffic, track mileage and rolling stock for the past seven years within the State. This corresponds to the fiscal year ending June 30th. Note the decrease in passenger traffic, 1908 to 1909, to which may be ascribed about half of the retrenchment in rolling stock, i. e., car equipment is about 18 months behind in normal growth.

ment can only be brought about by thorough re-routing in the terminal district to equalize more logically the distribution of cars according to the available street capacity. This will require widened roadways, new tracks, extensions, new streets and a new terminal loop system centering in Exchange Place.

These improvements cannot be carried out without the co-operation of the City and the acceptance by its citizens of reasonable recommendations for relief. The Company seems to have been influenced in the past to adopt certain routings not calculated to serve the best interests of the City as a whole. But a broad-minded policy of re-routing should now be adopted to care for the future as well as the present. And it is especially important that the City should not be niggardly in its provisions for proper routing. The City has now reached a point where it has outgrown its streets without having exerted itself toward a general improvement. Street widening is necessarily expensive now, but it usually becomes more so as time goes on, especially along those thoroughfares which are a logical necessity for traction service. The Eddy Street widening is a good start. Where present prices are prohibitive the sidewalks must be sacrificed, or else new streets cut through property of less value.

It is an established principle borne out in every municipality that transportation is the key-note to development, and that realty values generally reflect the conditions of local transportation. This is borne out in a most astonishing manner in northern Manhattan Island, where the realty values rose in five years after the building of the present subway, to an amount equal to more than the entire cost of the subway proper from the Battery north. It is, therefore, emphasized

that the City cannot afford to avoid provision for future development, nor, on the other hand, can the Corporation afford to neglect this provision in its own domain; if anything, it should be somewhat in advance of the population in its extension, for only by this means can it enlarge its radius of activity and include in its tributaries the suburban population which unquestionably must be ultimately diverted to the steam roads if reasonable facilities are not available on the electric lines.

It is not a function of this report to consider the relations between electric and steam service, both of which are handled in Providence by the same corporation. It should be said, however, that even though both steam and electric lines are under one management, this fact by itself constitutes no valid reason for forcing an interchange of traffic desirable to the Corporation but opposed by the patrons. As a general principle, transportation must be furnished where it is demanded. The only way in which a corporation should accomplish a desired diversion of traffic from steam to electric lines or vice versa is not by curtailing the one, but by improving the other so greatly as to insure its immediate acceptance. After such a demonstration, public animosity will not be aroused by the change, such as would be the case if the situation was forced by the deliberate curtailing of one division of the service.

The Corporation is now in a position where the hostility of the Public prevents it asking for and executing improvements really needed and where operating conditions are officially sanctioned, which would not be permitted against its better judgment under more fortunate relations. The essential thing

for the Corporation is to encourage increase in the riding habit. This can only be done by good service. Adequate service requires friendly co-operation between Public and Company; consequently, no enlightened management would deliberately tolerate obvious short-comings within the organization, which would tend to seriously reduce its earning capacity, if these could be avoided.

But it cannot safely be assumed by the City that its co-operation in the matter of thoroughfare improvements will necessarily be reciprocated in the improved service anticipated to a proportionate degree. And the only way in which the City can be assured that it is receiving the degree of service equivalent to its rightful expectations is by the systematic recording of service provided. The keeping of this record in the form of cars and seats operated and passengers carried, transfers, accidents, new equipment, maintenance, etc., should become a specific function of some branch of the City government. Partaking of none of the characteristics of public utility regulation, it is merely a running record of value received, based upon periodical reports from the Corporation and occasionally checked as conditions warrant by actual observation.

It is firmly believed that the maintenance of such an official record would secure and perpetuate the relations desired between the Company and the Public by virtue of the positive character of the record. Without this, a change in the policy of the management, which is liable to occur at any time, might easily result in a nullification of advantages which the City had a right to expect in return for its liberality in the matter of thoroughfares and other concessions to the Company.

The past has demonstrated that local opposition has been chiefly instrumental in defeating meritorious plans for betterment; for example, Exchange Place tracks and the East Side tunnel. Both of these commendable improvements have been voluntarily offered by the Company, and finally rejected by the City for reasons which now appear to be inadequate. Undue conservatism usually brings but one result,—to retard the normal healthy development of a community, or at the most, to develop it along erratic lines.

The great necessity in constructive public work is foresight. The tendency is too much to cut the pattern to the cloth. Thoroughfare improvements are particularly hampered by this hand-to-mouth policy. It is believed that with the resources of the City of Providence, a program of improvements should be inaugurated covering a term of years, that will go far to rectify the present congested conditions respecting transportation along its streets. Comprehensive re-routing at this time will unquestionably relieve present conditions, but the future will not care for itself, and such a program of public improvement should have in view serving the thousands of additional citizens to come within the City's borders or suburbs. Clipping a curb here and there will not accomplish such a result; an adequate East side approach or tunnel will.

TRANSPORTATION ABOUT PROVIDENCE.

Synopsis: *Development of radial arteries and outlying sub-centers. Absence of crosstown lines encouraged abuse of transfers. Topography forced erratic expansion. East side development most needed. Short haul to be encouraged. District co-operation essential. Competition of steam lines dependent upon frequency of service.*

The City of Providence is primarily a radial city in the development of thoroughfares and settlement, as distinguished from a city of rectangular streets, such as Philadelphia. This results in an important advantage: it secures the shortest running time between residence districts and business center. But, unfortunately, it also tends to contract instead of expand this business center, which becomes more congested as time goes on, because of the tendency of all business to locate at the hub. This, however, would not be a serious matter if suitable cross streets were available to permit of inner and outer distributing loops. Unfortunately, such streets are either unavailable or exceedingly cramped in the City of Providence.

Such a radial development necessarily produces sub-centers in the outlying districts, such as Olneyville, Watchemoket, etc. A nucleus for one of these centers is apparently already developing in Elmwood, and others will probably develop in the future. (Trackage map. Plate I.)

Cross-Town Traffic. A radial system of thoroughfares pro-

vided with no cross streets must, therefore, only aggravate down-town congestion, because of the impossibility of diverting traffic to the circumference instead of its traversing the business center as it does in Providence. At the present time there is a large traffic between Olneyville and East Providence, or contiguous towns. Here is a logical start for outside routing,—via Point street bridge.

In the absence of this provision the abuse of the transfer privilege has arisen. In order to meet the demand of citizens to reach contiguous suburban territory as easily as possible, the transfer privilege has been made more liberal, making it possible, for example, for Eddy street passengers to double back on Broad street. This itself is permissible, but it introduces a much more serious matter, viz., round-trip riding to the business center for one fare. It is, therefore, apparent that if the transfer privilege be restricted so as to prevent such abuse, an equivalent must be provided in the shape of cross-town lines, selecting those for immediate construction for which a demand actually exists, and adding others later.

Topography. The topography of Providence District, in common with other cities, has largely influenced its growth; and those who object to the apparent favoritism in the development of certain suburban areas by improved traction facilities to the exclusion of others, will do well to study the topography of the district before assuming that undue discrimination has been practiced. Providence must expand. Shut in as it is at the west, its natural expansion is towards the south and east, especially southward along the long glacial plane reaching to Greenwich Bay, which offers almost unlimited opportunity for the most desirable suburban residence. Likewise, the shore

line of East Providence should develop rapidly if provided with both electric express and local service.

But the most serious impediment to developing the City proper uniformly, is the Prospect Hill barrier which has maintained a strictly residential section not only upon the Hill, but in the district beyond. Some citizens advocate this isolation as a means of preventing business encroachments, but it is believed that the maintenance of a desirable residential territory on the East side, so close at hand to the business center, does not necessitate the continuance of inadequate car service with which this district may only be furnished until some means is found of overcoming the physical obstruction of College Hill.

The so-called East Side is commonly considered as the district between North Main street and the Seekonk River. This district lies within a 1½ miles radius of the City Hall. But this is not the entire East side, for this division of the City should include all the contiguous portions of East Providence as far as Pawtucket.

It should be realized that, in the East Providence district today, from fifty to sixty thousand people reside, who will be directly affected by any improvement plans. This is a greater population than the entire City of Providence in 1865. As emphasized elsewhere, imaginary boundary lines cannot define or control the broad movements in suburban growth.

East Providence, by virtue of its location, is as much a part of the East side development problem as that section served by Blackstone Boulevard. The existence of country clubs along the east shore of the Seekonk River, and the fact that the cross-city travel between Olneyville and Rumford and Phillips-

dale is the heaviest of any of the through routes, evidences this inseparable community of interest.

The work of the East Side Approach Commission is, therefore, of the highest order of importance, and it is to be highly commended in its efforts to establish the most direct thoroughfare possible between the business center and the Seekonk district. Suburban development, invariably, follows quickly in the wake of improved transportation; and if a short haul suburb can be made available within the three-mile zone, where four, five, and six miles in other directions are now necessary to reach the same character of residential acreage, such improvements are desirable, both by reason of the time saved to the people and the earnings of the corporation.

Long Haul. It must never be lost sight of, that the decrease in profits on long haul traffic invariably means a reduction in service elsewhere in the City. Along with the tendency towards expansion it occurs that the five-cent fare zone is being pushed further and further outward, necessitating correspondingly longer haul. If the Corporation is giving adequate service with a reasonable return on investment, the lesser profit on this long haul business must be balanced by increased profit on the short haul business, due to gradual solidification of the central districts. When a city has developed almost exclusively in its distant suburbs, the city proper must suffer if a financial balance is to be maintained in its transportation.

It is, therefore, incumbent upon the City to develop its nearest suburbs first, gradually expanding as the densities reach a comfortable maximum. Consequently, some form of an East side approach cannot be consistently opposed upon any grounds other than personal preferment at the expense of the greater City.

District Co-operation. Any conception of urban population, as limited to any precise municipal boundaries, is distinctly short-sighted. The real boundaries of the city must be where the people cease to reside. Therefore, any consideration of such an important problem as transportation which affects the whole district, not simply the city proper, must be characterized by sufficient breadth of view to avoid any possibility of entertaining petty differences and jealousies between sections lying within and without the present city borders, respectively. For the same reason a comprehensive policy of development for the district requires close and friendly co-operation between the municipal authorities of Providence and contiguous centers. Whether there may be existing differences along other lines, it is absolutely essential that transportation should not be handicapped by such differences as have no bearing upon the important development policy. Other large cities, notably Boston and London, have recognized the essential nature of this policy by establishing a metropolitan district control in which all contiguous boroughs and towns participate with the proper representatives.

Steam Railroad Competition. The New York, New Haven & Hartford Railroad Company operates from five to ten local trains per day along the steam lines, southward, and through other territory served by the surface system. But the infrequency of trains reduces the matter of competition to one of minor importance; in fact, it seems to be the policy of the management to shift to the traction system all local business. This may be inferred from the recent reduction of the Olneyville steam service, either directly or through an increase in fares.

The fast electric service operated directly from Union Station through the East side tunnel now totals 58 trains per day to the east shore towns of Riverside, Warren, Bristol, Barrington, etc., and thence to Fall River. This service has no connection with the Rhode Island Company's lines, but affects its business considerably by serving the same territory. In spite of this competition, however, the Riverside surface line is one of the best earning lines in the system. Likewise the Pawtucket surface lines, although there are twenty-four local trains per day stopping there. This seems to indicate the importance of surface trolley lines even with high speed competition. The secret of success is frequency of service.

GROWTH OF THE PROVIDENCE DISTRICT.

Synopsis: Traction district tributary to Providence. Union R. R. Division or 5 cent fare zone. Estimate for 1925, half million persons involved. Lowest density on East side. Distribution generally uniform. Realty values doubled in twenty-five years. Record Bank Clearing in 1910. Company behind on equipment orders. Earnings per capita, Union Division, good. Riding doubled in twelve years. Estimate 80% increase in earnings by 1925.

Any consideration of traction service would be short-sighted if only provision for the present were made. Municipal growth, if at all thriving, occurs so rapidly that it is difficult to keep pace with it, and in all parts of the country municipalities and public utilities are oppressed by the demand for extensions and improvements which cannot adequately be met, however urgent their need.

In the short time available for the study of the growth of the Providence traction district, it has been impossible to attempt a very accurate analysis of growth, but sufficient data is contained in the report to form a basis for at least general conclusions. The points to be developed are as follows: First, the probable growth of the traction district tributary to Providence; second, the earnings resulting from such growth; third,

the service necessary in track mileage, car mileage and car equipment, to meet this growth.

The problem further divides itself into two distinct parts; the growth of the entire traction district and the growth of the minor civil divisions of the district. The former concerns the question of service as a whole; the latter is largely a question of re-routing.

In Providence District, the subject is complicated by the extensive interurban travel to such other centers as Woonsocket and Fall River. It is, therefore, difficult to define just what territory is strictly tributary. Applying a well known standard, if we include those towns having minor commercial interests here, such as shopping, this district includes the territory lying practically within a ten-mile radius from City Hall, including such adjacent communities as Pawtucket and Cranston. The population of the five-cent fare zone unfortunately can only be estimated, owing to the extended boundaries of the surrounding towns. This population, however, about coincides with the operations of the Union Railroad Division. The dilution resulting from occasional extension beyond the five-cent fare zone is not serious.

On the other hand, the traction district tributary to the entire Rhode Island Company's system covers from Greenwich Bay to Woonsocket, including the latter city and the intervening communities.

Population. The growth curve of the population of Providence City possesses irregularities due to territorial increase, which makes it desirable to study the present City from 1875. Since that time the growth has been consistent, and actually maintained the same percentage growth in the last two five-year census periods. The growth curve is shown on Fig. 2,

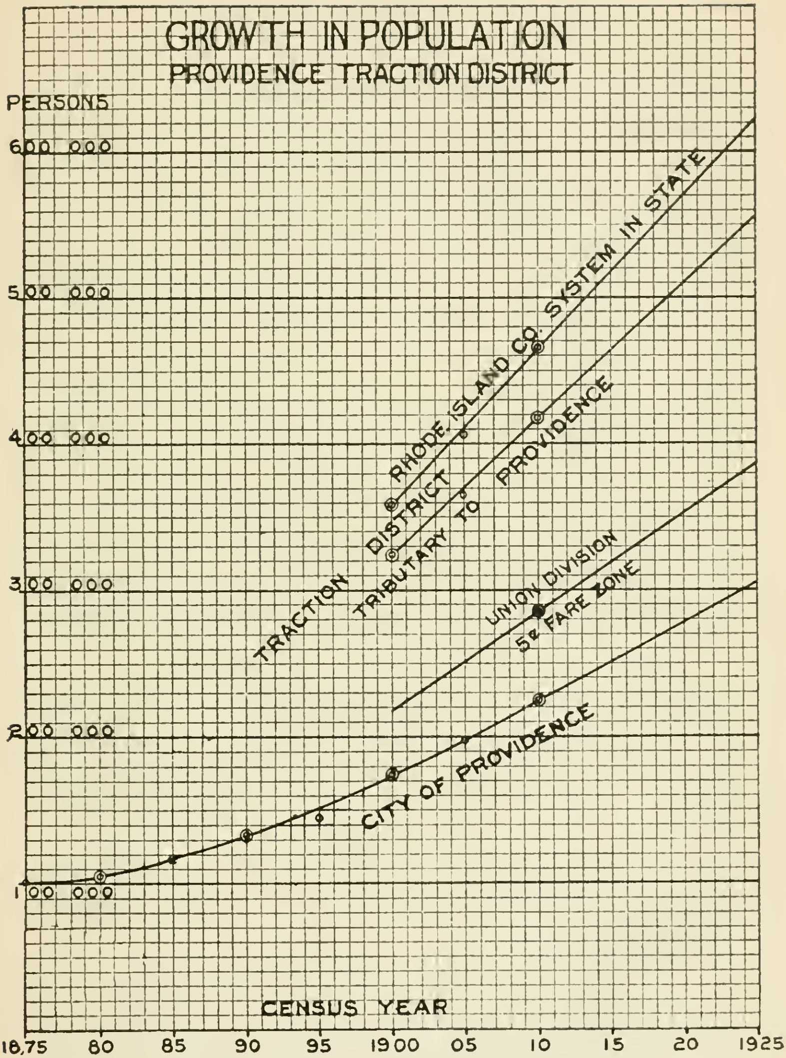

FIGURE 2—GROWTH IN POPULATION.

Showing the uninterrupted growth of the City of Providence for the last 35 years. The double circles indicate U. S. census. The upward curvature shows that the population of Providence is increasing faster than a fixed number of people per decade. However, to be conservative, the population has been forecasted for the next 15 years on this basis of a fixed increase. The population of the traction district similarly forecasted, shows about the same percentage increase. In normal growth, the population forecasted for 1925 would presumably be exceeded in all cases.

and projected to the year 1925 on the basis of a fixed increase in population per year, as indicated by the last three five-year periods. This is considered a minimum estimate, disregarding, of course, the interference of some future catastrophe or extraordinary business depression. Thus, the City of Providence will probably contain over 300,000 persons fifteen years hence, barring territorial extensions. The City's population, as a whole, increased 27.5% in the last decade, as compared with Boston, 19.6%; Buffalo, 20%; Cleveland, 46.9%; Pittsburgh, 18.2%; San Francisco, 21.6%; Milwaukee, 31%; Detroit, 63%, and Los Angeles, 211%. The population has doubled itself about every 20 to 25 years, the last period being 26 years. Many cities double in less time than this. Considering the time required to inaugurate, legislate and execute a broad movement for the City betterment, it is evidently imperative to anticipate as far as possible this rapid growth.

The traction district tributary to Providence City, projected into the future, shows an increased population from 418,000 in 1910, to about 555,000 persons fifteen years hence, or 33% increase.

The five-cent fare zone* may be expected to increase about the same as the City, or increase from 286,000 at present to 386,000 persons in 1925.

Finally, the entire district tributary to the Rhode Island Company in the State approximates 465,000 persons at the present time, and will presumably reach 620,000 fifteen years hence. A tributary population of one-half million is, therefore, the minimum consideration in any study affecting Providence. Whether the communities at present outlying continue

* See fare zone map—Plate II.

to operate separately is quite unimportant in the matter of traction service, as the interests of Providence and these communities are one and inseparable.

Density. The approximate distribution of this population over the Providence District is shown graphically on Plate III, by means of density shading. Thus, the ninth ward of Providence contains the maximum density of the entire District, 66.4 people per acre, while the second ward, known as the upper East side, contains only 10.1 persons per acre. For the entire City the average density is 19.25 persons per acre. Pawtucket also has two dense wards. The outlying towns cover such large areas of unsettled territories that only a general comparison is possible. In Cranston, Warwick, Johnston and East Providence there is, of course, ample opportunity for unlimited development. East Providence averages only 1¼ persons per acre.

The area of Providence is 18.28 square miles, but although a radial city, owing to geographic barriers suburban development has been forced along extremely irregular lines, so that the real City extends in effect in various directions to the four or five-mile circle from the City Hall, covering an area of practically 50 square miles. Yet in the very heart of the District within a radius of two or three miles a choice undeveloped section of the East side is located, undeveloped because of the absence of a suitable channel for such development.

Distribution. Plate III also shows the rather uniform growth of these respective districts since 1900. It is thus seen that all of the districts have experienced some growth, South Providence and the northern sections, however, showing the maximum increase, exceeding the East Side by a considerable margin.

For a more accurate idea of the actual distribution of the population within the City limits it has been possible to show this in Plate IV, by enumerating districts, of which there are 129. As each district was platted to purposely cover about 2,000 people the distribution may very accurately be shown by means of the dot map, the scale of which is here 100 persons to the dot. From this exhibit it is apparent that below an approximately east-west diameter Providence is very uniformly settled, and that the only remaining thin areas are the northwestern section traversed by Smith street and the upper East Side. From a traction standpoint it is fortunate indeed that this uniform settlement of the City exists, a fact which contributes greatly to the possibility of high density of traffic and short haul.

Realty. The realty valuation of Providence aggregated $90,000,000 in 1910; this valuation has doubled in twenty-five years, that is, since 1885, and, moreover, it is growing faster than the population. In many cities it grows still faster, in some cases trebling while the population doubles. Therefore, the funds available for public improvements from an even assessment mileage will increase in the future faster than the population, which should offer encouragement to ultra-conservative citizens.

Bank Clearings. Perhaps the best index of material growth in a large city is the Bank Clearings, which also reflect accurately the general condition of prosperity upon which a street railway is dependent for its income. Starting with the year 1898, when commercial prosperity was resumed after a prolonged depression, the clearings increased by irregular steps from $226,000,000 to $415,000,000 —156%. During the same

period, traction earnings increased from $1,550,000 to $3,315,000, or 112.5%. This is shown graphically in Fig. 3. Thus for 1898 the earnings represented 0.58% of the clearings; in 1910, 0.8%. This means that the Railway Company earned $1.00 for every $172.00 clearings in 1898 and $125.00 in 1910, indicating that transportation in Providence is becoming more and more indispensible to the patrons and valuable to the company. In other cities, Pittsburgh for example, it has been found that earnings grew at about the same rate as clearings. Here for the past seven years surface railways have earned $1.00 for every $250.00 clearings, not including steam suburban service. The high level in Providence, and especially the growth, should therefore be regarded as very encouraging.

In 1909 business had practically recovered from the depression of 1907 and the record for the past year is the highest in the City's history.

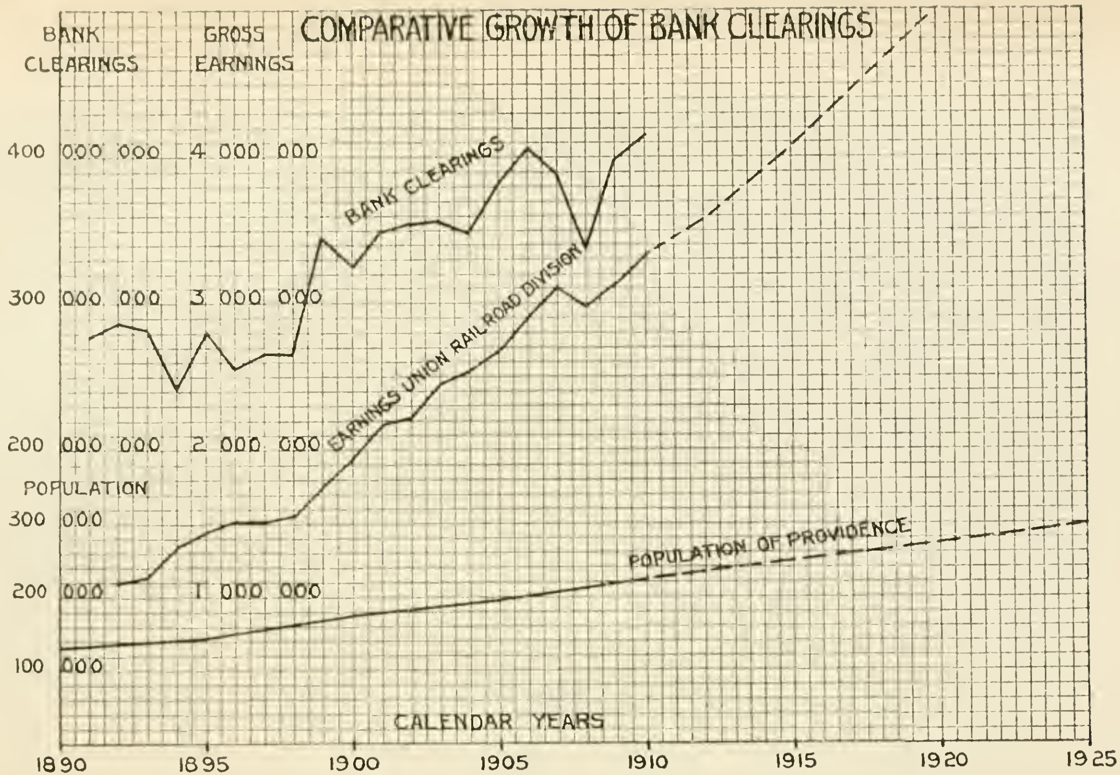

FIGURE 3—RELATIVE BUSINESS GROWTH—BANK CLEARINGS.

As an index of general business prosperity, bank clearings are compared graphically with traction earnings and population. From this it appears that within the past ten years traction earnings have increased faster than clearings, i. e., are becoming relatively more important in the business life of the community.

THE RHODE ISLAND COMPANY.

*The record of growth in track mileage, revenue, passenger traffic and car equipment of the Rhode Island Company's system within the State for the past ten years is shown on Fig. 1. During the year 1907 the system was expanded by the acquisition of other properties. Neglecting this rise, the increase in trackage was 24.87 miles in six years, or 4.14 miles per year over the entire system.

The passenger traffic suffered one severe slump in 1908-09. For the entire period of seven years, however, the total increase amounted to over 31,000,000 passengers—61.4%—or 8.75% per year average. The record of equipment shows an abrupt halt since 1907, after a steady increase for three or four years previous. However, considering the above mentioned slump in traffic in 1907-08, this retrenchment seems justifiable only for the year 1908. It is apparent that the Company did not accurately anticipate the demands of the increase in traffic that took place thereafter; in other words, it is now about one and one-half years behind in car equipment. Between 1903 and 1907 the passenger traffic increased 43%, the car equipment 21%; by 1910 the increase in traffic had distanced the equipment by 62% or nearly three times.

Union and City Divisions. †The gross earnings and mileage for the Union Division and for the City of Providence, respectively, are shown on Fig. 4. The total gross earnings increased steadily from 1893 up to the slump of 1907-08. In the track mileage a sharp increase occurred in 1900, but the growth has been uniform since—31.31 miles in ten years, or 3.13 miles per year. This record is shown in Table 3.

* Railroad Commissioners Reports—Table 2.
† Union Division outlines—Plate V.

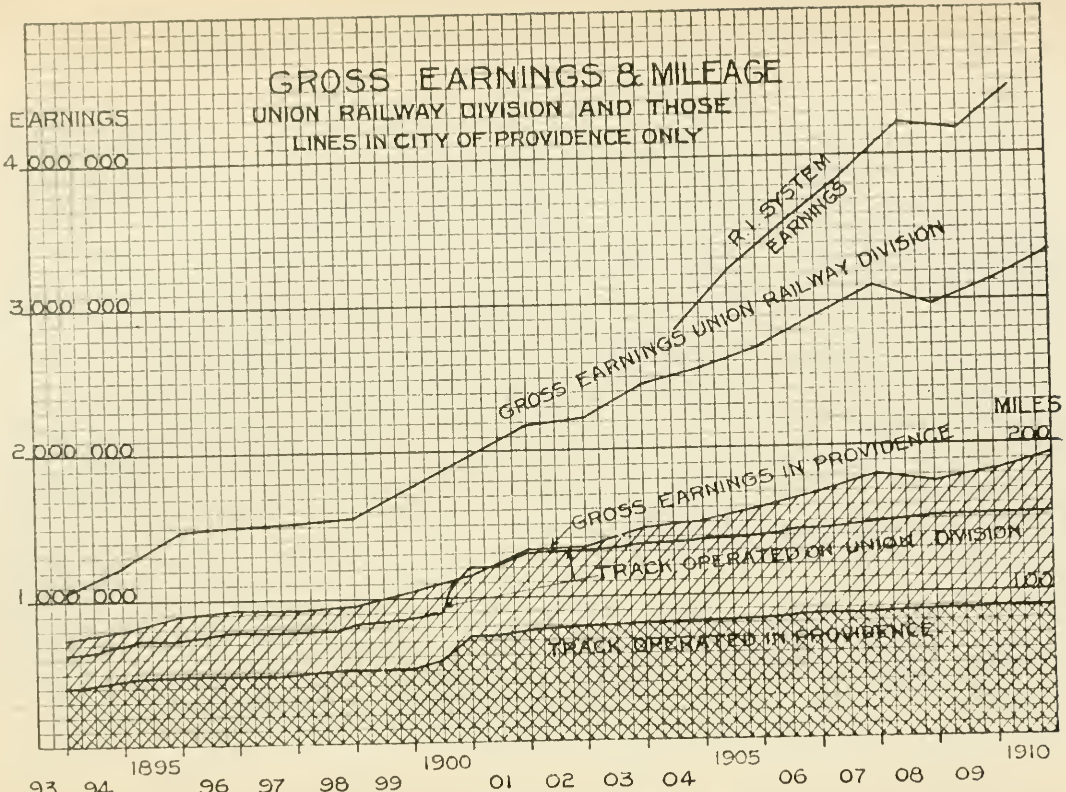

FIGURE 4—GROSS EARNINGS AND MILEAGE.

Tracing the increase in track mileage and gross earnings for the City of Providence and for the Union Division since 1894. For comparison the earnings for the entire Rhode Island System are included since 1904. It will be noted that the proportion of trackage and earnings, assigned to the City of Providence, has increased but slightly for many years past. In 1910 it was 72.4%.

Taking this last decade, the record shows an increase of 69.8% in gross earnings (66% for the City of Providence), and 26% in trackage (20% for the City) or 2.53 miles per year, (1.48 miles for the City). In 1910 the proportion of the City mileage and earnings to the total mileage and earnings of the Union Division was 72.4%. This proportion has been increasing somewhat during the ten years, but has not increased materially since 1905.

The single track mileage in Providence for the past ten years has increased about as fast as the population of the district served, which indicates normal growth. The past three years, however, shows a disposition to retrench in the matter of extensions, which, if continued, will sooner or later bring about unsatisfactory development of the City proper. Thus, in 1910 there were 3.95 miles of track per 10,000 persons; in 1900, 4.0 miles; in 1903, 4.5 miles approximately.

Earnings Per Capita. It is impossible to determine without excessive labor and expense the earnings per capita of resident population for the so-called Providence Traction District. Did the five-cent fare zone coincide with the City limits, it would be an easy matter to determine with great accuracy the earnings per capita thereon. But for the present purpose an approximation of the district served by the Union Division will suffice.

First, considering the Rhode Island System, as a whole, for that portion of the State which it occupies, it is found that the earnings per capita approximate $9.70 for the year 1910, and the ratio has increased rapidly since the Company began operation in 1903, when they were only $6.75 per capita. (Table 5.)

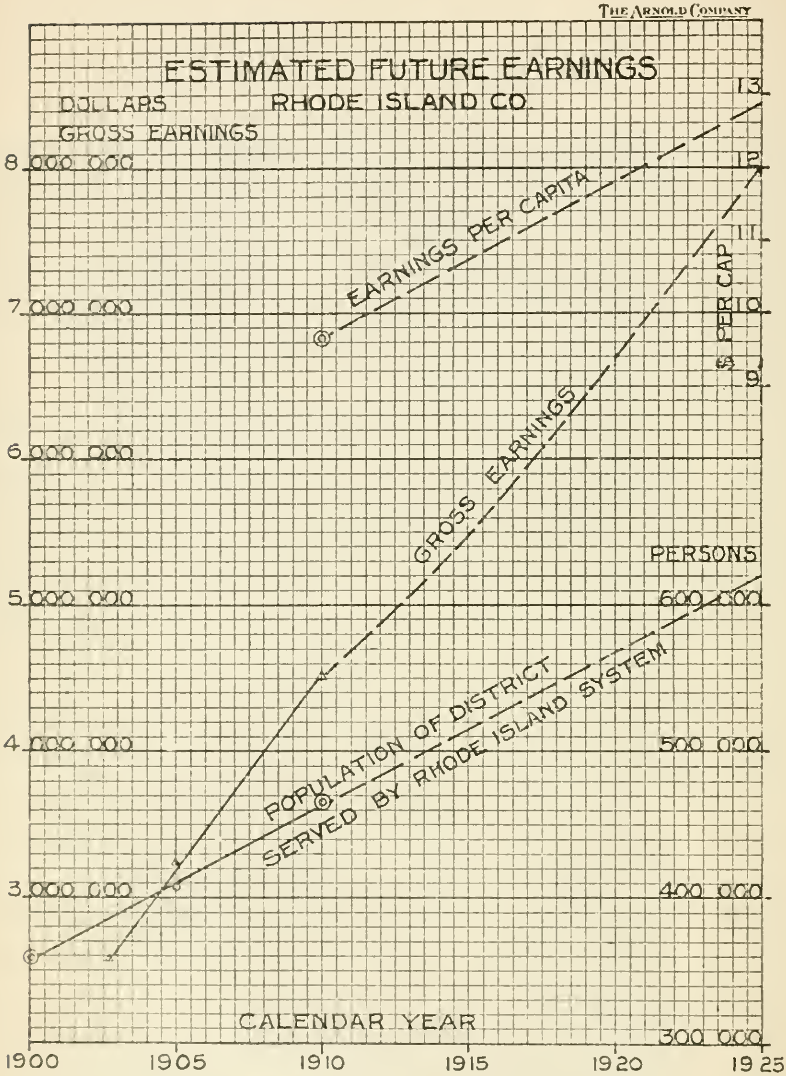

FIGURE 5—FUTURE EARNINGS.

Representing graphically a forecast of earnings of the Rhode Island Company for the State in 1925. This is based upon the law previousy developed, see Figure 6,—that gross earnings increase about as fast as the square of the population, i. e., earnings per capita increase directly as the population. For this purpose, the forecast in population is made by the straight line method as in Figure 2, which is considered very conservative.

From a comprehensive study of other cities the fact has been developed that the earnings per capita increase at about the same rate as the population increases. In Fig. 5, earnings per capita are projected into the future in agreement with this law, indicating nearly $12.90 per capita in the year 1925 with a population of 620,000 people. The gross earnings of the system will, therefore, presumably increase from $4,500,000 during 1910, to nearly $8,000,000 fifteen years hence, barring financial depressions of unusual severity. That this estimate is minimum is shown by the drooping of the extended curve of earnings.

Now, for the City of Providence only, the earnings per capita have steadily increased, with the exception of a few fluctuations, from about $6.00 in 1895 to $8.55 in 1910. The data for census' years shows an exactly uniform increase. Therefore, starting with the population and earnings of the City proper in 1910, and projecting into the future, we may expect in 1925, $11.36 per capita, or about $3,500,000 per year.

For the Union Division district the earnings appear to be relatively higher. Starting with $11.57 per capita in 1910, the present five-cent fare zone will earn in 1925 over $6,000,000 per year. Hence, an increase in business of over 80% must be provided for.

It is worthy of note that the earnings per capita of the City alone is considerably lower than those of the Union Railroad Division or five-cent fare zone.

The extent of riding on trolley lines about Providence may be judged from the following annual registrations for the year 1910 on a basis of five-cent or revenue fares:

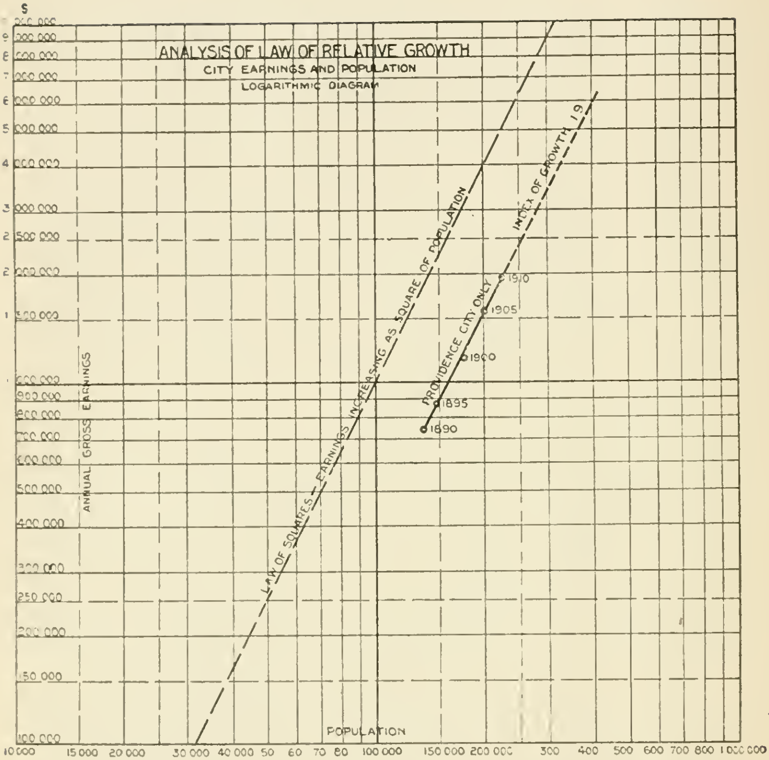

FIGURE 6—ANALYSIS OF LAW OF INCREASE EARNINGS.

To predict future earnings accurately requires an analysis of the law of growth of earnings and population. This diagram shows graphically that, based upon the last thirty years, earnings in Providence are increasing as the 1.9 power of the population, i. e., nearly as the square—a result which has already been developed from a study of the fifteen larger cities of the United States. This law means that when the population doubles, earnings will quadruple. The dotted line indicates this law of the square. A line parallel thereto must conform to the same law, which is practically the case for Providence. This is to be regarded as the most encouraging fact in the whole traction situation in Providence.

Rhode Island System for State,	82,790,000
Union Railroad Division,	66,630,000
City of Providence,	38,450,000

The City riding has more than doubled in twelve years, and taking into consideration the gradual increase in transfer traffic the total riding will increase faster than the earnings, i. e., faster than the square of the population. This relation is of the greatest importance in giving some idea of the future growth to be anticipated and provided for. Fig. 6 represents a graphical analysis of the law for the City of Providence since 1890. For this period, annual street railway earnings have grown at a rate equivalent to the 1.9 power of the growth in population, i. e., nearly as the square (2.0 power) upon the present basis of apportionment of the City earnings. This law of the square, in a general way, has been found to apply to other cities, even to a city of the magnitude of Greater New York.

Car Mileage. Records of car mileage are not available for many years back, so that the growth of this important measure of service cannot be obtained. Assuming, however, a reasonable operating ratio and return on investment, it is a simple matter to calculate the car mileage that should be operated each year. This operating ratio should normally remain constant, providing depreciation is properly met year by year. The increase in service is, therefore, dictated by the proportionate increase in earnings. For the past four years the record (Fig. 7) shows no increase in car mileage. However, during three years, 1907-08-09, there was no increase in total passengers or earnings, due to the business depression. But, in 1910, both passengers and earnings made higher records. During the last year, the car mileage has not increased proportionately.

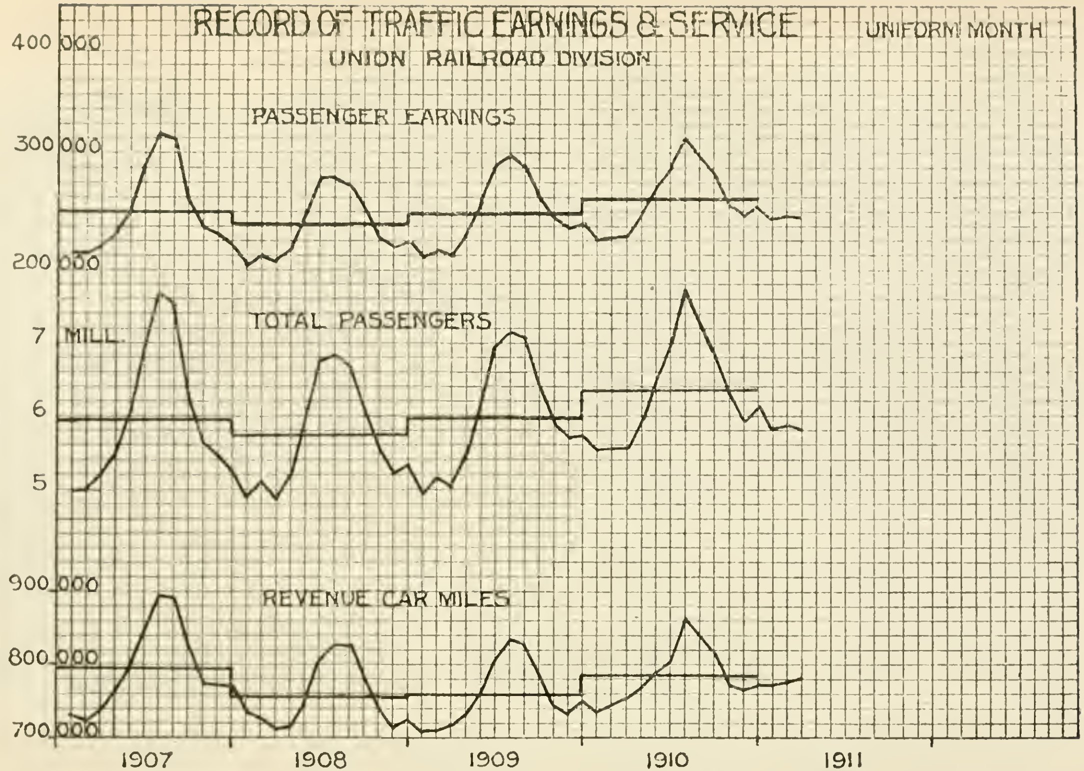

FIGURE 7—RECORD OF TRAFFIC AND SERVICE.

These curves trace the seasonal, as well as yearly changes, in passenger earnings, total passengers carried and revenue car miles for the Union Division. All data is reduced to a basis of a uniform month, 30.4 days. While the excess traffic of summer and winter is quite apparent, it will also be noted that, during the four years earnings, and passengers have increased, but car miles have decreased, indicating relatively poorer service for the same equipment.

PASSENGER TRAFFIC IN THE TERMINAL DISTRICT.

Synopsis: Determination of outbound travel during typical rush hour. Nine outlet throats. Average loading 133.5% *of seats furnished. Loading increases with shorter interval of observation. Heaviest* 20-*minute period,* 164% *at one throat. Maximum loading about* 6 *P. M. Spacing of cars often irregular. Seats furnished practically equal to schedule. Service doubled during rush hour. Company's standard of maximum car loading, reasonable. February and March travel lowest in year; December* 13.6% *higher than March; July* 38.3% *higher.*

Any study of transportation requirements necessarily involves an accurate determination of passenger travel. Maximum crowding with closed cars usually occurs during inclement winter weather and passenger counts at the various outlet throats from the loading district, therefore, will provide an accurate measure of service requirements.

Providence, as a radial city, has only nine such outlet throats through which all outbound car lines must pass. As soon as practicable after the beginning of the present investigation, passenger counts were conducted at these points, which are as follows, listed in the order of their importance:

Broad & Winter streets,	2,240	seats	scheduled
North Main & Mill streets,	1,962	"	"
Westminster & Cranston streets,	1,804	"	"
Broadway & Federal streets,	1,162	"	"
Wickenden & Traverse streets,	1,002	"	"
College Hill,	858	"	"
Eddy & Manchester streets,	782	"	"
Francis & Promenade streets,	724	"	"
Friendship & Chestnut streets,	568	"	"
Total, loading district,	11,102	"	"

The evening rush hour, 5:30 to 6:30, was investigated for typical maximum rush hour travel, inasmuch as morning rush hour conditions usually spread over a longer period of time, and hence show less concentrated loading.

It must not be assumed that these throat counts indicate the actual flow of traffic during every day in the year. On the other hand, they must only be regarded as a typical study. Rush hour travel varies more or less from day to day, from week to week and month to month due to weather conditions, shopping excursions, parades, and all manner of irregular influences. For a precise statement, continuous counts must be made, but these are obviously burdensome and expensive as compared to the results achieved. Moreover, the changes in routing contemplated will entirely modify the distribution of traffic flow through the various throats.

Counts. The counts made at the four most important points first listed were duplicated on different days as a check, and were found to be in close agreement.

These counts, as shown on Plate VI, indicate the amount of car,† seat and passenger flow passing a given observation point of maximum loading, and thus indicate not only the relative loading, but also the time of transit and regularity of spacing; i. e., headway on each individual route passing each point.

Table 8 gives the findings in detail. Thus, the average loading was found to be 133.5% of the seats furnished; i. e., 14,730 passengers and 11,036 seats, while the individual throats averaged, in the order of importance above listed, 133%, 118%, 145%, 141%, 142%, 143%, 132%, 147% and 102% respectively. Broadway, Westminster, Wickenden and Francis street cars appear to be the heaviest loaded.

As a private check on the accuracy of these counts, the Company stationed inspectors at the same points and independently obtained very nearly the same results for the traffic as a whole. Thus, the average traffic of the nine throats was found to be 133.5% of the seating capacity by the City's count and 128% by the railway's. The individual throats, however, showed considerably greater variation.

A supplementary count at the Olneyville Square throat on May 2nd showed an average loading for the rush hour of only about 80% of the seats furnished, based on standard winter equipment. With part summer equipment in operation at that time, the average loading was only 66.6%.

In an analysis of service standards an important point is the interval of observation. Thus, while 133.5% loading for the rush hour may not appear excessive, when the interval is narrowed down to thirty minutes or less much greater maximum loading appears. This is shown by Table 9 accom-

†Compare with composite diagram of all lines—Plate XXI.

panying the shaded curves, Fig 8, which are plotted by ten-minute, but shaded for twenty-minute intervals. With a ten-minute headway an interval of ten minutes will, of course, give individual car loading, which is easily liable to be 100% or greater. Consequently, the greater variation appears on the lighter lines, such as at Francis street.

The choice of the interval should be with the idea of determining a fair average loading, which will suppress unavoidable single car loads and yet take cognizance of extreme irregularity in operation. The twenty-minute period has, therefore, been taken for Providence conditions. The count shows a variation for the entire loading district during twenty-minute periods of from 123.6% to 141%, with a maximum variation at single throats from 89% to 164%. During twenty-minute periods the heaviest loading occurs at College Hill, Wickenden and Francis streets, with Broadway and Westminster street in nearly the same class. For this same interval, outbound traffic reached a maximum rate of 21,900 passengers per hour, and seats furnished, 15,500 per hour which is considerably greater than the average for the hour, due to the numerous short-trippers.

The period of heaviest loading seems to occur after six o'clock in the majority of cases, and holds well on to 6:30 P. M.; in other words, the outbound traffic originating at about six o'clock produces the heavy loading.

The frequency of car travel is indicated by the fact that at Westminster and Cranston streets and Broad and Winter streets, there is about one car a minute passing on the average, and the irregularity of headway is magnified by this very frequency. Thus, at Broad and Winter streets an interval of 6½ minutes was noted without any cars passing,

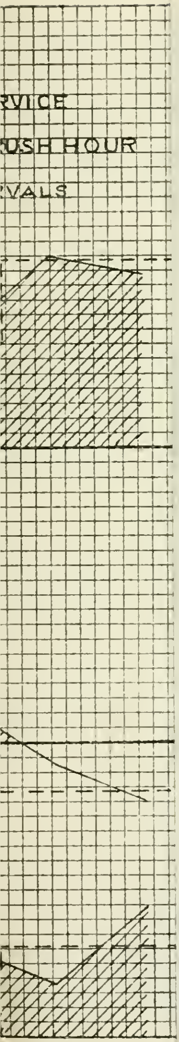

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FIG. 8

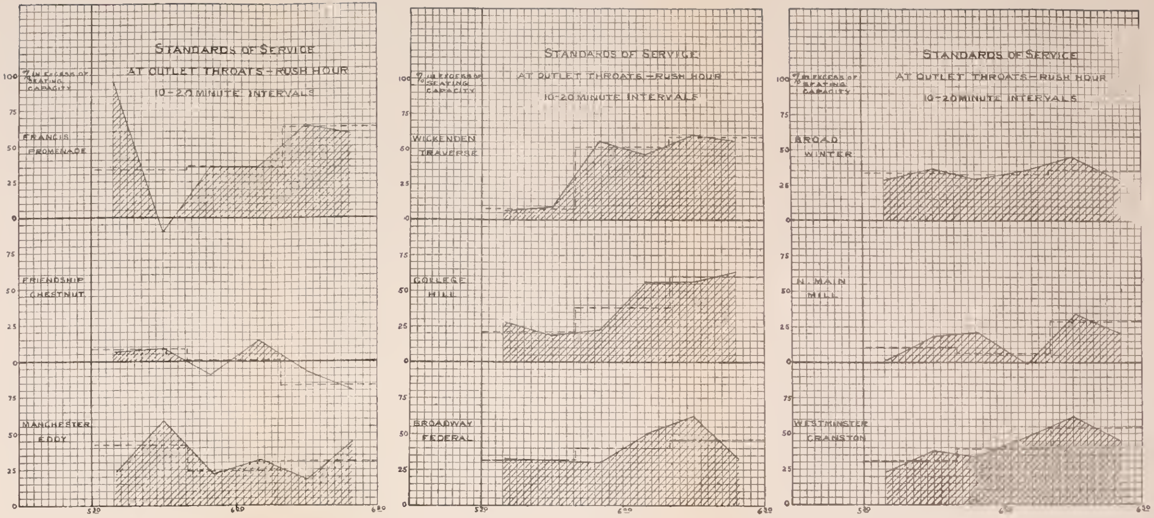

FIGURE 8—STANDARD OF SERVICE AT OUTLET THROATS.

Indicating the average standing loads observed during rush hour intervals The shaded diagram represents average standing for 10 minute intervals, the dotted lines for 20 minute intervals, both expressed as per cent load in excess of seating capacity. During the longer interval, the fluctuations are, of course, less marked. In most cases the maximum loading is reached about 6 15 P. M. At Friendship and Chestnut, practically seated load continued throughout the rush hour.

and one of 8¾ minutes at College Hill. On the other hand, cars quite frequently come along in bunches of three or four. This irregularity is the cause of much complaint, and is clearly shown on the accompanying plotted records.

It may be argued that these irregularities are unavoidable in the down-town district, but the individual routes shown beneath the throat count in Plate VI indicate that all of the irregularity is not due to obstruction in the down-town district. This is also indicated by the fact that the inbound cars do not run at intervals, even though not having reached the down-town district.

A most important comparison is the actual and scheduled seats passing; in other words, whether the Company operates all of the equipment that is scheduled. The counts show that this is the case for the system as a whole, but that individual throats vary considerably. Thus, Broadway and Francis street were 15% to 20% short of schedule, while Wickenden street was 7%, Eddy street 10% and Friendship street 25% above schedule. This irregularity may be due to either a shortage of cars, or to the Company's practice in measuring the car service by the fluctuating demands from day to day, whether departing from the schedule or not. It is believed that such a procedure gives rise to warrantable dissatisfaction on the part of the patrons who cannot be expected to keep abreast of frequent changes in schedule, especially when unannounced. The regular cars should at least be operated strictly on schedule. The fact that the schedule as a total is maintained indicates that some lines are favored at the expense of others.

An essential measure of service is the proportion of rush hour to normal or non-rush hour service.† The Company's schedule provides for 11% more service during mid-day and 102% more during rush hours than at normal hours. It has already been noted that as a total, the entire service rendered was found to be equal to the schedule. This, then, is a condition for which the Company is to be commended. The standard of double service at rush hours is admittedly good, and if adhered to, indicates the Company's desire to justly meet all reasonable demands of rush-hour patrons. Of course, it must be assumed that the normal standard of service is adequate. This is a question that can only be determined by all-day records of individual routes for the purpose of determining the characteristics of each route. It must not be assumed that a car is overloaded because showing high registration for the trip, for in many routes double and triple loading is encountered, especially on through routes.

Satisfactory service for non-rush hours should be such that during a given period, for example, twenty minutes, there should pass by a given point of maximum loading as many seats as there are passengers to be carried during that period.

All lines do not require double service for rush hours. Thus, for long haul suburban lines, such as Oaklawn, the schedule is the same for rush hours as for normal hours; while Branch avenue and Academy—Taunton avenue is doubled—200% of normal service; Pawtuxet, 243%; Friendship—Admiral, 275%; and Auburn trippers over 300%.

The Company's method of assigning reasonable capacity of equipment during rush hours is to station inspectors at the

†See winter operating schedule—Table 20.

various throats above indicated. If on three successive days cars appear to be loaded beyond a certain limit, additional trippers are ordered into service, and vice versa. The maximum standard in force is as follows:

42 seat new Bradley cars—70	passengers—loading	167%	of
44 cross-seat interburban—50	" — "	114%	seating
36 " " suburban—60	" — "	167%	capacity.
34 longitudinal seat cars—70	" — "	200%	
26 " " " —42	" — "	162%	

This standard is entirely reasonable, provided, of course, that it is rigidly enforced, with the exception of thirty-four seat-class cars, and its effectiveness is entirely dependent upon whether sufficient reserve equipment† is available.

Finally, it should be noted that the monthly records indicate that traffic in February and March is the lowest for the year. As discussed under "Service Requirements," the average for the year is 15.6% higher than March traffic. December 13.6% higher than March (16,740 passengers rush hour) and July 38.3% higher than March (20,380 passengers rush hour). This summer maximum, however, is not strictly coincident with rush hour travel, but December is entirely so. The result of these counts must, therefore, be considered only in the light of representing the *best conditions* of winter service. As observed, they are not unfavorable, but with the additional loading of December they could be materially improved upon, largely through the medium of more rigid adherence to schedule which would operate to smooth out the irregularities of individual car loading.

†See schedule of rolling stock Table 10.

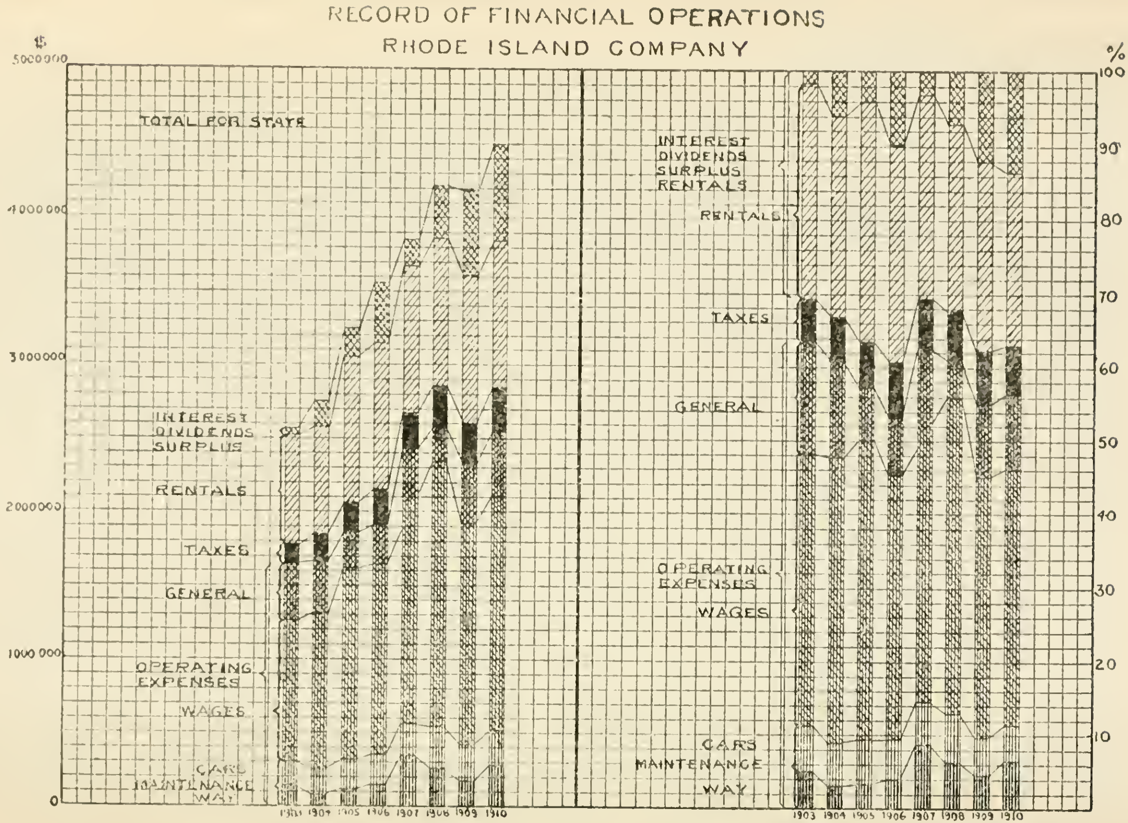

FIGURE 9—RECORD OF FINANCIAL OPERATIONS.

A graphical analysis of the income account, showing, on the left hand, yearly changes in the total amounts and, on the right hand, these same changes expressed in percent. of the total income, i. e.—indicating how the nickel is spent in Providence. Note the history of the maintenance account on the one hand and the surplusage on the other.

SERVICE REQUIREMENTS OF PROVIDENCE DISTRICT.

Synopsis: *Service capable of exact calculation. Proper car mileage for* 1910, 17.2% *increase over March. Actual mileage less than* 1907. *Density of service per mile of track, low; earnings, few. Population, per mile of route,* 13,700 *maximum,* 3,000 *average. Service requirements in* 1925 *near doubled. Increase in Track,* 36 *miles per year. Rush hour loading standard,* 133%. *Proper winter service,* 13.4% *increase.* 375 *cars required on winter schedule—* 1910-11. *Present equipment sufficient with faster schedule. Increase required* 20 *cars per year.*

The computation of service is essentially an arithmetical problem. It answers the question—How many car miles should be operated annually for a given income, and how should this mileage be distributed?

At the outset a decision must be made as to what proportion of the income is reasonably available for purchasing service. An analysis of the Rhode Island Company's financial statement of the last eight fiscal years from State and Railroad Commissioners' reports is shown in Fig. 9. Referring to this it will be noted that the operating expenses of the entire system, including maintenance, plus taxes paid to the City and State, aggregate from 60% to 70% of the gross income. It will also be noted that this percentage

varied considerably in the eight years recorded, increasing sharply between 1896 and 1897, subsequently decreasing in about the same rate as the four years previous. The average for the eight years is slightly over 65%. (See Income Account, Table 2.)

Operating Ratio. For the purpose of discussion, we will assume 70% as the proper operating ratio, including taxes and also annual payments into a depreciation reserve fund, which does not seem to have been provided for directly in the present Company's finances, especially, prior to the change operating expenses, strictly speaking, should be apportioned in control in 1906-07. For a special consideration of "Providence City" alone, or for the "five-cent fare zone" alone, to the respective areas; but as a precise apportionment for the City is a practical impossibility, it is believed to be sufficiently accurate to take the same operating ratio for the "Union Division" as reported for the entire Rhode Island system. As a matter of fact the Union Division ratio is slightly higher. If the balance of the system traversed only thinly populated rural territory, this proportion might not be sufficiently accurate; but as the system includes the local lines of both Pawtucket and Woonsocket with comparatively little long haul country mileage, it is believed that the comparison will hold. This is borne out by the fact that the earnings per capita for the system appear to be somewhat higher than for Providence City, as those earnings are now apportioned.

Now, for the year 1910 the earnings in the Union Division amounted to $3,315,149. Assume that 70% of these earnings, or $2,320,604 were available for the purchase of ser-

vice in the form of car miles. A reasonable value for car mile unit (earnings per car mile) is open for discussion, and varies in the different large cities from about 24c. to 28c., including those having a goodly proportion of large capacity rolling stock. On the other hand, a short haul city, such as Providence, necessarily shows a tendency towards higher earnings per car mile than a long haul city.

Car Mileage. Assuming, then, as high earnings as 30c. per car mile for the Union Division of Providence justifying a total operating expense of 21c. per car mile, the Company should have operated approximately 11,050,000 car miles per year; or at 27½c. per car mile earnings, approximately 12,050,000 car miles should be operated. This may be regarded as a reasonable range in the amount of service that the Providence District may expect from its earnings, guaranteeing a reasonable return on capital invested, and making allowance for a reasonable depreciation for taking care of the property in the future out of earnings.

Operating records are not available for but a few years past, so that it is impossible to determine accurately the history of the service in Providence. In 1910 the Company operated 9,427,787 car miles.

Since 1907 the car mileage not only has not increased, but has actually decreased (up to June 30, 1910). Unquestionably, the records for the closing fiscal year of 1911 will show an improvement due to the addition of the fifty 42-seat cars. The fact remains, however, that whereas during the three years above mentioned the total passenger traffic increased 6.75%, the car mileage decreased 1.1%. There are only two possible explanations: First, that the size of cars

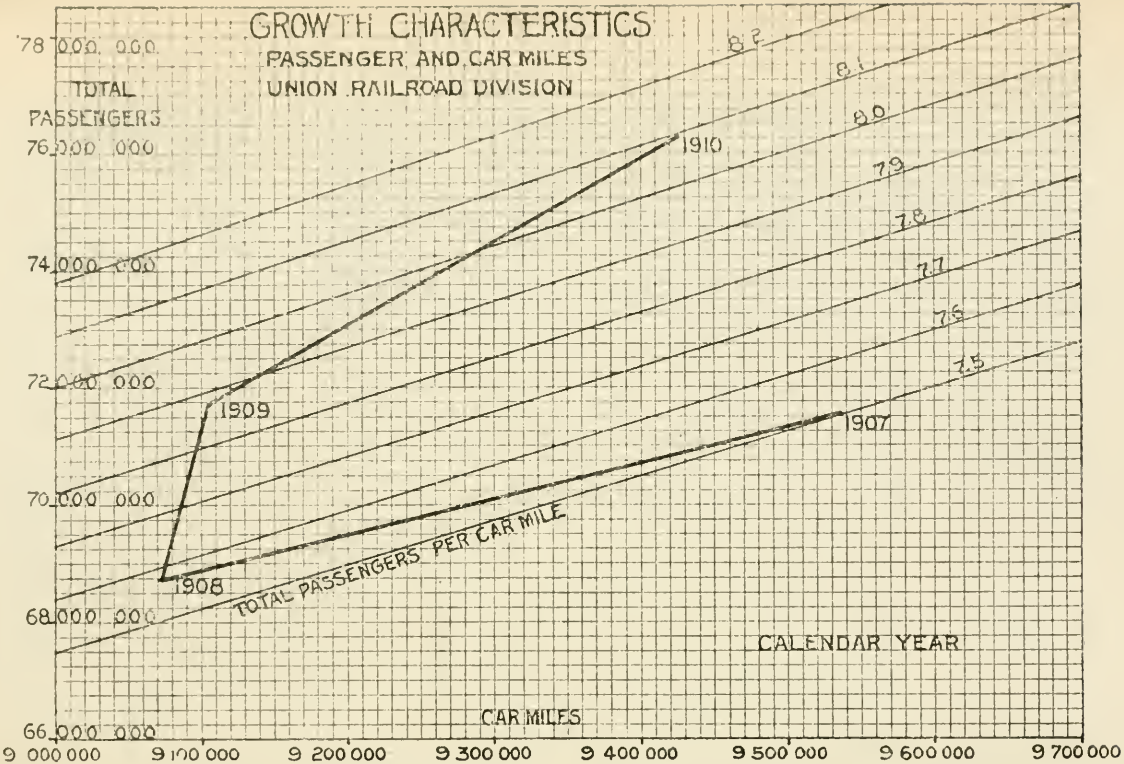

FIGURE 10—GROWTH CHARACTERISTICS.

Graphical analysis of the simultaneous changes in service and traffic. For the same car equipment, retrenchments and expansion in service should follow traffic directly, i. e., in the same proportion, which would result in a constant ratio of passengers per car mile. The history of the last three years' changes for the Union Division is shown above;—1st. less car miles, 2nd, more passengers, 3rd, increase in passengers per car mile from 7.5 to 8.1, representing proportionately less service per passenger.

has increased during the three years enough to make up the difference, or second, that the service has been proportionately reduced, as indicated by Fig. 10. As no new equipment was put in operation during this period on the Rhode Island system, there still may have been some shifting of equipment from other divisions to Providence; but as the large cars have only lately been adopted as a standard, it is hardly possible that such reassignment could have materially affected the accuracy of the above conclusions.

It was, therefore, incumbent upon the Company to increase its car mileage at least to the minimum above established, representing an increase of 1,622,300 car miles or 17.2% for the calendar year 1910. It is only just, however, to point out distinctly that this does not mean a proportionate increase in equipment, necessarily; for with faster schedule speed secured by improved thoroughfares contemplated in this report a large increase in car mileage will be possible with the present equipment. And it is justly due the Company that such increased speed be permitted and encouraged by the City authorities in the future.

For the year 1911, assuming no improvements in creating faster schedules is made, it appears that an increase of about 10% in car mileage would be warranted, judging by the steady growth in traffic since 1898. This is equivalent to a total of 12,150,000 car miles per year, 2,722,000 car miles or 28.9% more than *actually* operated during the year of 1910.

Density. The present density of service in car miles per mile of single track (per year) averages for the entire five-cent fare zone 61,800 per mile. This is considerably lower than other urban traction systems not unduly expanded in

trackage. This is no doubt due somewhat to the low average speed. Moreover, the density has decreased slightly since 1907. This density ratio is inversely proportional to the average headway between cars; i. e., as the headway decreases the car mileage per mile of track increases which means better service.

A similar ratio, earnings per mile of track, reflects the combined density and riding habit of the population tributary to the traction lines. In 1910 the earnings of the Union Division averaged $21,740 per mile, slightly greater than in 1907, but about the same as for the past fifteen years. For the entire Rhode Island system the earnings averaged $14,200 per mile in 1910. Both ratios compare favorably with other railway systems of similar character. (See Table 6.)

The density of tributary population averages 2,500 per mile of single track for the City of Providence or nearly 3,000 per mile of route. But on one line, along Atwells and Academy avenues, it reaches a maximum of 13,700 per mile of route, a fact which indicates the necessity of double tracking a line of such heavy traffic.

Future Increase. If the earnings of the Union Division or five-cent zone are projected into the future at about the same rate as Providence traction district, Fig. 5, Page 56, it is found that in 1925 the earnings will approximate $6,000,000, and with this same operating ratio of 70%, $4,200,000 would be available for purchasing service. In the intervening period, with the growth of Providence, we should expect that the liberality in service would reduce the earnings per car mile to at least 27½c., which would prescribe 21,800,000 car miles per year, on the basis of the present five-cent zone

covered by the Union Railroad Division, an increase of approximately 97% over that estimated for 1910.

Undoubtedly within this period the City limits will expand and with it the limits of the five-cent fare zone. However, expansion will presumably take place after and not before the advent of thickly settled population, so that about the same normal density of traffic now encountered in the present five-cent fare zone may be reasonably expected in the expanded future fare zone. In other words, the total car mileage operated per year should increase as fast or faster than the annual gross earnings.

Trackage. Trackage should increase about as fast as the population until the district is fully developed. At such time the traffic density is bound to increase owing to the congestion. But in a system of unlimited boundaries such as Providence the dilution of outlying lines will always be present as the City expands, even though the density in the City proper increases also.

Starting on the present basis, $20,000 earnings per mile of single track within the Union Division, the normal increase in population and earnings estimated for the year 1925 about 35%, would require about 206 miles of single track within the district. If the district limits did not expand, the earnings and population per mile of track would steadily increase, but an advanced policy of development makes it necessary to build additional lines of track or to double-track existing lines, so that even though the fare zone limits do not expand materially the trackage within these limits will have kept pace with the growth. Using, then, the above basis, the Union Division should expand not less than 3.6 miles per

year, approximately; since the year 1901, it has increased 2.53 miles per year. The program for the present season contemplates 4.417 miles (inclusive of turnouts) in addition to 6.99 miles of track renewals, rerailing and repairs.

Seating Capacity. Seating capacity should increase about as fast as the passenger traffic, unless the schedule speed may be increased by some means so as to operate more car miles with the same equipment.

In a city like Providence, where the maximum evening peak is sharply defined, capacity should be estimated as that necessary to handle this peak. This will represent the maximum equipment required, irrespective of a certain number of cars always held in reserve. Passenger counts at the outlet throats during March show about 14,730 passengers and 11,036 seats per hour outbound, and about half this for the heaviest twenty-minute period, equivalent to a rate of 21,900 passengers per hour. If we were to limit the standing load as high as 100% of the seating capacity of the car during the heaviest twenty-minute period, then seats would be required at the rate of 10,950 per hour. As a matter of fact, seats were furnished at the maximum rate of 15,500 per hour during this period and the loading was 141% of the seats. Even for ten-minute periods, the maximum loading was but 147.6% for the system or 164% for any one throat. The above rate for the entire rush hour corresponds to 133.5% loading (33.5% standing).

This uniform loading through the various periods of the rush hour, therefore, indicates an efficient guaging of rush hour travel. We may then accept 133% average hourly loading as a not unreasonable basis of service, as it can be furnished without hardship in the City of Providence.

The seating capacity adequate for normal hours is then a matter of judgment. In cities where the rush traffic is not so sudden as in Providence, the ratio between normal and rush hour service need not be as great, but in Providence the ratio of 1 to 2 is practically a necessity. This standard would then require 7,575 seats per hour throughout the day, at the lowest estimate.

Passenger counts during March showed 11,036 seats per hour operated and 11,102 seats scheduled. This indicates that the Company is operating practically all of its scheduled equipment.

Were the March requirements representative of the maximum for the entire year the rate of service furnished would not be questionable, but the record of monthly traffic, reduced to an average month of 30.4 days, shows that February and March are the minimum of the year in total passengers, car miles and earnings. In 1910 the average monthly traffic was 15.6% above March, December being 13.55% and July 38.25% higher than March. Hence, the minimum requirements for the maximum winter rush hour of 1910 may be stated as about 12,600 seats per hour for 16,740 passengers, and the summer requirements 15,250 seats per hour. This latter estimate, however, may be somewhat in excess, owing to the fact that in summer much of the maximum loading occurs during the day, while in winter it occurs chiefly during the rush hour. But the December estimate calls for an increase of 13.4% on the present winter rush hour schedule.

Cars. Standard cars are not used throughout the system, and this will have to be the case until all the small single

truck cars have been retired; consequently, a capacity factor must be applied to these results, which compensates for the lesser capacity of the small cars. Now, the average winter car seats 34.79, and the summer car 59.9 passengers, or an average for the year of 43.1 passengers, practically equal to the standard Bradley box car. Consequently, the maximum winter requirement was 362 cars per hour of the present type, assuming as above, an average rush hour loading of 133%.

These estimates refer, of course, to rate of car movement outbound from the down-town terminal district. They have no reference to actual number of cars in service on the lines. This latter is entirely determined by the length of haul and running time. The present winter schedule calls for 331 cars averaging 34.79 seats. On the basis of the present rush hour schedule, therefore, an increase in equipment of 13.4% or a total of 375 cars of the present type should have been in operation on the Union Division during the rush hours of December, 1910.

The schedule of equipment, Table 10, shows that 360 cars were available prior to the delivery of the new Bradley cars or 410 total at the present time. Hence, it is clear that had the new equipment been in commission in December, service requirements would have been fully met, leaving 8.5% of the equipment for reserve or under repair. However, some of the equipment will need to be retired at an early date.

Finally, it is only just to emphasize that these requirements will be greatly modified by the proposed increase in schedule speed, which will be found desirable and quite possible as a result of the re-routing and thoroughfare improvements contemplated by this report. An increase in schedule

speed will be accompanied by about the same relative decrease in car hours, which means that for the same service in car mileage, less cars will be required; or, conversely, the same number of cars will be able to make more mileage and handle more passengers. Hence, it is clear that the increased winter requirements as estimated above, might be fulfilled with the present equipment operating under a proportionately faster schedule, which would entail no increase in expense for platform labor over the present.

In the gradual change of rolling stock from small single truck to large double truck cars, a railway should not attempt to replace small by large cars in less number, strictly adjusting seats to passenger demand. On the other hand, the increased capacity possessed by the large rolling stock should be used as an encouragement of the riding habit which will usually respond thereto within a reasonable time. This is to be regarded as good practice in anticipating the future, and it is quite in contrast to the short-sighted policy of withdrawing from the streets a number of cars in proportion to the excess seating capacity of the new over the old equipment. Frequency of car service (that is, headway) should not ordinarily be reduced after once it is established.

For the future, car equipment in service should increase with passenger traffic. It has been estimated that a traffic increase of 80% must be provided for within the next 15 years. Just what is the proper rate of increase in equipment is difficult to estimate on account of the increased mileage per car to be expected from improved routing. However, the rate is equivalent to only twenty cars per year, while for the actual increase from 1901 to 1907 the record shows an aver-

age of 50 cars per year for the Rhode Island system, 85% of which, or 43 cars, should have been assigned to the Union Division. The above estimate of twenty cars per year represents, of course, the maximum new equipment required to meet normal growth only, and not for retiring old equipment, so that it must be assumed that the entire rolling stock is maintained up to a reasonable standard of repair.

GENERAL IMPROVEMENTS IN SERVICE.

Synopsis: Schedule of speed low for radial thoroughfares. Delay mostly in loading district. Suburban development requires 30-minute service. Street cars should be restricted no more than undirected vehicles. 15% saving in time estimated from re-routing. Average spacing of white posts, 243 feet, should be doubled. Abolish counter operation. Automatic signals and electric switches necessary. City must regulate vehicles. Multiple car stops. Emergency routing. Avoid transfer abuse by cross-town service and distinctive colors. Turnouts and double tracks. Suburban express necessary. Broadway express. East side-West side electrification. Electric freight and terminal development.

The most important phases of this subject are schedule speed, express service, headway and redistribution of service. All other matters largely hinge upon these. The last named subjects are discussed later under "Re-routing."

Schedule Speed. The average schedule speed that is in force for the City proper and its immediate suburbs is 7.96 miles per hour from terminus to terminus. This figure is a true average obtained by taking into account the distance and running time of each individual line and is not an arith-

metical average of all lines. However, counting from a point outside the terminal district where reasonably free running begins the average speed is 8.71 miles per hour.

Both these speeds are lower than they should be. While the present delay in the terminal district is largely unavoidable under existing conditions, better time should be made outside considering that a large number of these lines pass through sparsely settled suburban territory where free running is possible. Such is the case with the Riverside, Pawtucket, Oaklawn and Branch avenue lines. This does not mean that the entire suburban runs are taken into consideration in determining the above average speed as the schedules analyzed extend only to the actual settled limits of the City; i. e., to the limits of the Union Division.

Some of these lines are extremely low in schedule speed; thus, Prairie avenue, 6.49; Ocean street, 6.38; Arlington, 6.63; Broadway, 6.27; Rumford, 6.75; Dexter street, 6.82; Friendship street and Dyer avenue, 6.54, each. On the other hand, other lines make extremely good time: Promenade street, 9.20; Smithfield avenue, 9.98; Pawtucket, 9.00; and the suburban lines,—Fall River, 9.24; Buttonwoods via Broad street, 10.62; Buttonwoods via Elmwood avenue, 9.14. Outside of the terminal loading district this Buttonwoods express via Broad street averages 12.18 miles per hour.

In Table 11 are listed a few typical sections of different routes, wherein the running speed may be classed as slow, medium and rapid. This shows that the speed within the terminal loading district of about 3½ miles is not more than ordinary walking speed, and that the speed on the important thoroughfares, such as Broad, Westminster and

Cranston streets, of about 6½ miles per hour is also exceedingly slow. The rapid and medium sections show the character of running that is possible where traffic interference and excessive stops are not encountered (from 9 to 12 miles per hour), and the contrast between these speeds and the average speeds for the entire route bring out clearly the character of the congestion encountered down-town; thus, on Broadway the running speed clear of obstructions is 9.40 miles per hour, whereas for the entire route it is 6.27.

These latter figures are shown graphically on the accompanying time zone map, Plate VII, which records by successive contour zones the distance on various routes that may be traversed in five-minute periods. In the loading district the time is counted, not necessarily from the actual terminal, but from the logical point of loading which introduces some unavoidable irregularities in the area of the first five-minute zone. It will be noted that the increased schedule speed in the outlying district is reflected in the increasing width between successive contour lines; for example, Pawtucket-East Providence from Arlington corners to Pawtucket, and Cranston Print Works to Knightsville.

Considering the running speed in Providence, it will be apparent from this map that it ought to be possible to reach any point within the five-mile zone in less time than thirty minutes. At present it requires twenty-five minutes to reach Pawtucket, 3½ miles distant; Allendale, 4 miles; Pomham, 4½ miles; Rumford, 3½ miles; and thirty minutes to reach Manton, 3 miles distant; Cranston Print Works, 3½ miles; Auburn and Edgewood, 4 miles, each. Eddy street, which is the most direct thoroughfare to the southern suburbs, should

easily deliver passengers in Pawtuxet within thirty minutes.

In suburban development, the thirty-minute time zone practically marks the limit of isolation acceptable to the great majority of high-class residents. They cannot afford to spend more time per day unless unusual geographical conditions intervene, such as the case of the New Jersey Commuters. Beyond this limit the better class of suburbanites will transfer their patronage to steam roads operating suburban service, and unless these steam lines are routed in numerous directions it necessarily follows that an irregular suburban development will take place, dictated not by the desirability of the land available, but by the location of existing steam lines serving primarily the through steam traffic. In other words, for a radial city such as Providence, to develop itself in a normal manner in gradually expanding circles, local traction lines must include the settled districts within the thirty-minute zone as uniformly as possible, and the only way to expand this thirty-minute time zone without resorting to steam commuter service is to establish limited-stop electric express cars which will ultimately dictate the necessity of separate thoroughfares in order to save more time than the headway between local cars.

Ordinance Requirements. The maximum running speed is limited by City ordinances to six miles per hour in the loading district and from nine to twelve elsewhere, the majority of the lines coming under the nine mile class; thus: six miles per hour—Exchange Place, Market Square, Dorrance street, Washington street, Mathewson street, North and South Main streets, ½ mile circle. Ten miles per hour—Elmwood avenue, south Broad street, Prairie avenue, Eddy

street, Manton avenue, Chalkstone avenue, Francis street, Admiral street, and Branch avenue. Nine miles per hour all other streets.

These restrictions mean that if cars were actually limited to the speeds designated, even the present slow running schedule would not be possible. In normal operation stops alone consume from 15 to 30% of the time, acceleration and retardation perhaps 50% of the balance, so that the best schedule speed possible would not be over five miles per hour. Such operation would be clearly suicidal to the business of surface transportation, and a schedule satisfactory to patrons would absolutely necessitate the infraction of these maximum speeds imposed by ordinance. Automobiles and other vehicles are permitted fifteen miles per hour.

Observations on various routes show that the average running speed, exclusive of stops, does not exceed ten miles per hour, except on certain suburbans. This permits a schedule speed of only 8.71 miles per hour and in many cases from 6 to 7 miles. It is, therefore, urgently recommended that cars be permitted at least the same latitude of running speed as vehicles not operating upon a fixed roadbed. Cars fitted with air-brakes and fenders can be operated at least as fast as undirected vehicles for the same element of danger involved.

Saving in Time. To form an adequate conception of the saving in time to patrons, resulting from the contemplated increase in schedule speed, consider, for example, the run to Pawtuxet, the heaviest line of traffic in the city. Thirty-five minutes are at present required for the run of five miles. The average speed for the entire lines is 8.57; average out-

side of the business district (south of Richmond street) is 9.52, and average running speed after deducting stops, 10.76. About eight minutes are lost through the congestion occurring on the run to Richmond street, only .4 of a mile from the terminal. Assuming, for illustration, an increase in average schedule speed of only one mile an hour and a saving of five minutes within the business district, this would make it possible to reach Pawtuxet in about twenty-seven minutes, a saving of 8.7 minutes, or 25% of the running time at present. This may seem excessive, but not so for many of the present lines. It is believed that at least 15% can be saved in running time over the entire system by re-routing, and which would be realized by increasing the schedule speed one mile per hour, viz., to 8.96 miles per hour.

White Posts.† The average interval between white stopping posts within the settled limits of the City and immediate suburbs is approximately 250 feet, or twenty stops per mile, while the number by actual counts varies from 209 feet to 279 feet, an average interval of 243 feet. The standard block is 200 feet frontage, or approximately 250 feet between street centers. Thus, there exists a stop for practically every street, but as this 250 feet block exists only in the newer platted sections, while many of the older stretches have streets 300 feet to 400 feet apart, the number of stopping points must be considerably greater than the number of street intersections.

An average interval of 250 feet is entirely too short, and it is believed that it will impose no hardship to establish an interval at least twice as great or 500 feet, throughout the City, except that within the loading district the actual street intersections should, of course, be maintained, but outside, the

†See Table 12.

number of stops must be reduced if the Company is to materially increase its schedule speed. These revised stopping points must be assigned with absolute impartiality, as has apparently not been done in the past; thus, starting with an important intersection such as Cathedral Square, these white posts should be laid out as near 500 feet as possible and still register with the cross streets. Ocasional variations of this rule could be made to advantage to accommodate important public institutions or manufactories, but no private considerations should have weight. This reassignment should be carried out by actual inspections on the ground, and with full co-operation of City and Company representatives.

A large proportion of the newer residence plats approximate 600 feet in depth, with 500 feet spacing. It is, therefore, approximately true that alternate stops will serve a greater area for the same running time than stops at every street. These relative walking distances are indicated, Fig. 11. In other cities where an attempt has been made to solve the difficulty, stops are often limited to four or five long blocks when running between business and residence districts.

Schedule Delays. A frequent source of complaint in connection with single track lines is the car intereference at street intersections. There are two principal sources of interference: First, single track two-way operation at branch-offs from trunk lines, and second, single track line operating along a trunk line in counter-directions to reach a parallel street. A particularly flagrant case of the latter is at Constitution Hill, where Pawtucket cars are regularly held up for perhaps two minutes while Camp street cars descend the hill. At Weybosset and Richmond streets outbound Rich-

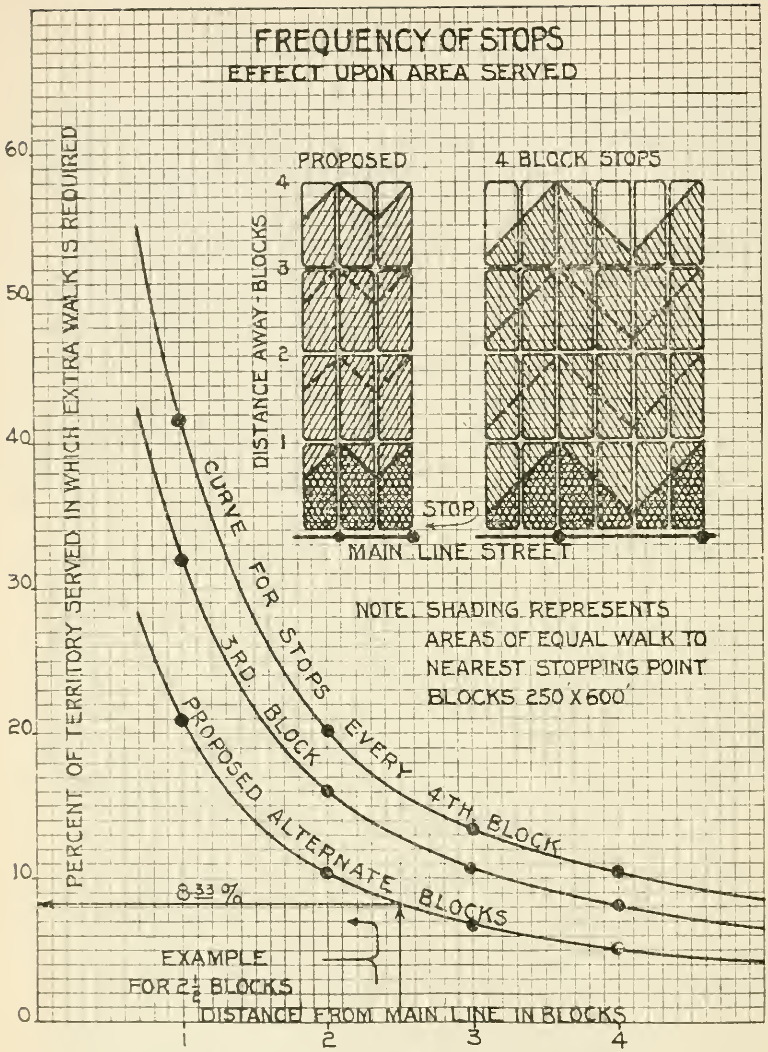

FIGURE 11—FREQUENCY OF STOPS.

Showing the effect of frequency of stops upon the areas served by a main line track. The shading defines areas of equal walk to the nearest stopping point. The curves indicate for how much of the territory served, 1, 2, 3, and 4 blocks distant, extra walk is required, i. e., which gives some idea of the relative number of people discommoded by the longer stops. Thus within 2½ blocks from the main line only 8 1-3% of the area require extra walk with 500 ft. stops.

mond street cars are often stranded across the main line to permit inbound cars to clear Richmond block. This may result in holding up ten or more main line cars. Another case of reverse operation is on Wickenden street, where Brook street cars run counter-travel. This intolerable condition fully emphasizes the great necessity of re-routing.

These waits, when the outgoing cars are off schedule, often amount to three or four minutes and are extremely exasperating to short haul passengers, such as East Siders, who could walk to their homes in less time. Even assuming a reasonable construction of schedules and location of turn-outs, congestion in the terminal district occasions delays of exceedingly variable duration with no opportunity to make up running time between terminal district and the first intersection of turn-out. Single track lines should, therefore, be *routed independently* if possible, of other lines of single track, so as to avoid off-schedule delays, or better still, routed on separate streets to avoid turn-outs. More liberal use of turn-outs would make it easier to get back on schedule than at present.

These causes, however, are not necessarily responsible for the general lack of promptness in the handling of cars, that may be found unfortunately on many railway systems. The assignment of a slow schedule to cover obstructions is objectionable enough to patrons without adding minor delays all along the line. The operating organization from despatchers down, should learn the value of seconds to be clipped here and there from the schedule. More rigid inspection and discipline will accomplish great results. Relief of thoroughfare obstructions will only make the other a possibility, not an actuality.

The use of automatic signals, inaugurated by the Company last year, is a very commendable move towards reducing one of the causes of delay in motorman having to leave the car to throw the switch clearing the block ahead. These signals have made possible a considerable decrease in running time.

Electric Switches. Observations at important switching points in the down-town district show that an undue amount of time is lost by motormen in switching. This results from the fact that they must first take time to open the door after coming to a stop, and in many cases leave the car to turn the switch tongue. The practice of leaving the vestibule window open, permitting them to turn the switch from the vestibule, would be rather impracticable with any system of prepayment cars. Moreover, this plan is not now followed in many cases; notably on Weybosset and Broad streets.

It is recommended, therefore, that electric switches be installed at all important intersections at least within the loading districts. One electric switch is now in use at Dorrance and Fulton streets, with obviously good results. It is claimed by the Company that the time required for hand switching in the majority of stops rarely exceeds that required for loading, but this is not borne out by observation made at ten down-town switching points; it was found that in the majority of stops extra time was required for switching. This excess time must be curtailed in the down-town district, and electric switches have proven a satisfactory solution of this difficulty in other cities.

Traffic-Regulation. The City imposes upon the Railway Company definite limitations as regards its rolling stock and other equipment occupying the streets. Hence, it is only

equitable that it should also impose similar regulations upon other vehicles. The majority of horse-drawn vehicles track wider than the prevailing railway gauge, 4 feet 8½ inches, and large numbers of "low gears" and auto trucks are found upon the streets, which occupy space out of all proportion to the available space for ordinary traffic. While the majority of vehicles are under 7 feet in width, there are large vehicles, such as barrel and brewery wagons, that exceed 8 feet. Owing to the prevailing narrow streets in the down-town district, the City should regulate the width of these extraordinary vehicles or else confine them to certain streets during certain hours, so as not to unduly impede general traffic.

The City gives prior right-of-way on its streets to fire apparatus, police and hospital. It should give street cars the second right-of-way with suitable penalties for fractious drivers. It is not unusual to observe a string of cars crawling behind an obstinate driver and a recent case was reported of an automobile deliberately holding up a Buttonwoods express for nearly a mile before turning out at a desired street. Such infractions should be severely dealt with.

The Company has adopted the correct type of rail for discouraging vehicles following the rail, or, in other words, to render it easy for them to leave the tracks. Having done its part in installing this grooved girder rail, it manifestly can do no more until the City meets it half-way in enforcing regulations against "track hogs." A few convictions will immediately have the desired moral effect and result in the greatest benefit to surface transportation. In this work the police department should, of course, co-operate.

Multiple Car Stops. At certain important loading points in the business district, such as Dorrance and Westminster

streets, great delay occurs between streets from waiting for the car ahead to load. This suggests the desirability of multiple loading; i. e., two or three cars permitted to stop and load simultaneously at the same corner. At present the rules prohibit cars running closer than 30 feet. This often results in a vehicle forcing its way between the cars delaying, to some extent, prompt movement. This can be obviated by permitting a group of two or three cars to follow at intervals just sufficient for a person to cross, and equivalent to a loading platform about 125 feet in length, or approximately half a block. This distance must, however, be designated clearly by suitable signs.

Night Service. Some criticism has been directed against the Company for the withdrawal of some night cars formerly operated for the convenience of patrons. It is believed that this is a method of securing high economies in operation which does not produce sufficient results to warrant the inconvenience to patrons. Night cars are necessarily run at a loss, but small cars may be used for this purpose. The headway on lines of any importance should not be more than sixty minutes; on lines such as Pawtucket or Pawtuxet, thirty minutes.

Emergency Service. The Company should provide adequate means of raising lines of fire hose or of crossing them during a prolonged conflagration, and install such emergency connections to its tracks as to enable cars to be temporarily re-routed, so as to avoid such obstructions as far as possible.

The Company should also be permitted to re-route its cars around unavoidable traffic obstructions during such times as parades, long funeral processions, etc., in order to avoid the certain demoralization of its service.

Cross-Town Service. With the gradual concentration of population and the formation of distinct local distant centres of business or residence in the various parts of the system, there will necessarily arise a demand for cross-town lines to connect these various sub-centres. Outlying thoroughfares should, therefore, be studied with a view to reserving them for immediate or future use for such cross-town lines.

The need for such service appears to exist at the present time for the important junction of Westminster and Cranston streets via Winter, Lockwood and Point streets across Point Street Bridge to the lower East Side or E. Providence, to eliminate the distance and delay in passing through the downtown business district.

A local business centre is now developing rapidly in Elmwood and suggests the future possibility of a cross-town line from Olneyville Square via Huntington and Potter avenues to this district, which line might reasonably be extended via Public street to South Providence, and possibly still further via Eddy street and Point street Bridge to East Providence.

In another instance where a community of interest certainly exists, a line suggests itself via Valley and Orms streets, connecting Olneyville and the manufacturing and transfer centre at Randall Square.

Each one of these trunk line crossings would ultimately develop into an important transfer point. At the start, the cross-town line might most readily be operated as a shuttle to be later extended as a belt line, or double tracked by means of parallel streets where available.

Transfers.† The volume of transfer traffic within the Union Division is considerably lower than would be expected

†Transfer zone maps—Plate VIII.

of a radial city with no cross-town lines. For 1910 it averaged less than 19%, and had increased by only a small margin since 1907. In other cities the percentage averages around 35%, up to 70% in Chicago, which is a city of rectangular street plan. This would seem to indicate that the operation of through routes in Providence has resulted in this great reduction in the transfer habit. Undoubtedly this is the case with many of the through routes, but it also occurs that some of them are the heaviest in transfers; thus, Prairie-Butler-Camp, 23.4%; Plainfield-Brook-Governor, 25.9%; Academy-Taunton, 26.8%; while on the Broad Street Loop line to Pawtuxet only 12.8% of the passengers use transfers.

The general results indicate that either the transfer habit is not fully cultivated here, that the present through routes have not been chosen to the best advantage for the needs of the majority of patrons or else that the transfer privilege is curtailed in some other way so as to be ineffective. This latter, however, is not the case, as practically universal transfers are in force, except that inbound suburban passengers boarding cars within the five-cent zone but outside of the transfer limits are not entitled to a transfer within the city. These transfer zones are in many cases outside of the city limits, as follows:

East Providence: North Broadway & Massasoit Avenue, Broadway Six Corners, Broadway & Warren Avenue.

Smithfield Avenue: St. Francis Cemetery.

Buttonwoods Line: Pawtuxet River.

This leads to the conclusion that, because of the directness of the thoroughfares in Providence and the numerous through routes provided, transfers are not as essential as in cities of rectangular layout, and consequently less used.

There appears, however, to be round trip riding owing to the final convergence of separate lines outbound from the city. Several cases of such transfer abuse are known to exist; i. e., Olneyville via Broadway, return via Westminster Street; Elmwood via Elmwood Avenue, return via Broad Street; South Providence via Broad Street, return via Friendship Street or Prairie Avenue; Washington Park via Broad Street, return via Eddy Street; Mt. Pleasant via Chalkstone Avenue, return via Academy Avenue; East Side via Camp Street, return via Hope Street. Presumably numerous other cases might be cited.

In one recent case parties boarded an Eddy street inbound local at New York Avenue at 7:15 P. M., returned on Edgewood & Pawtuxet Car via Broad Street, reaching destination at 9:30. The interval in town of 7:30 to 9:05 was covered by transfer and unquestioned by the conductor.

This abuse should be stopped by every reasonable means. It is a form of petty dishonesty which many citizens unfortunately indulge in, simply because it is possible, without considering the serious character of the offence. Every double ride means less service for the normal revenue riders, and in the end the entire city will benefit by its abolition.

No railway company should be called upon to provide a round trip for a single fare. It is true that a through route permits cross-town riding of perhaps the same distance for a single fare, but were this more prevalent, the company could not afford to do it. It is because only comparatively few people ride the entire distance of a through route, that the loss is negligible as compared with the profits from normally short haul routes, the greater convenience to its patrons, also the elimination of congestion due to extra down-town looping.

The simplest suggestion is a system prevailing in Chicago, where the transfer traffic reached tremendous proportions a few years ago. By means of colors the conductor is enabled to *refuse* a transfer tendered by a passenger returning in the same general direction from which he came. In other words, a passenger on a car from any district could not be transferred to another line reaching that same district, but could receive a transfer to any other district. The color of his transfer thus becomes evidence of error and relieves the conductor of the moral duty of refusing it.

In Providence, as the railway system is radial rather than rectangular, this would tend to simplify the situation; thus, Olneyville passengers could not receive transfers to any outbound line reaching Olneyville; similarly Mt. Pleasant, Smith Hill, North Providence, Constitution Hill, Capitol Hill, East Providence, Prospect Hill, south East Side, South Providence, Elmwood, Dexter Street, and Washington Park.

If this abuse is not curtailed it is liable to reach the proportions of a nefarious business with established points of deposit, where transfers could be bought and sold for one or two cents, as was the case in Chicago. It is believed that, if the citizens of Providence realize the seriousness of this traffic they will not become impatient at any restrictions that it may be necessary to impose in order to stamp it out.

Turn-Outs vs. Double Tracking. There is a logical time in the development of traffic along a given line when double-tracking should take place. In Providence this is a difficult matter, because of the absence of sufficiently wide roadways, but wherever possible double-track should be laid when a

given density of traffic has been reached. This density may be expressed in car miles per mile of single track operated. To illustrate the limitations, a five minute headway may be used. For eighteen hour operation, this corresponds to an annual total of 114,000 car miles per mile of track. Up to this point single track can be operated effectively with the proper number of turn-outs for accommodating the headway, but as a general rule, when necessary turn-outs are more frequent than three per mile, or 1,750 feet corresponding to an average of 2.5 minutes headway, double-tracking becomes advisable.

The average length of a turn-out is perhaps 280 feet, so that the additional cost of special work is in the end greater than straight double track. In Providence the minimum spacing of turn-outs is about 1,600 feet on Friendship street and 1,000 feet on Pocasset avenue. The latter street carries the traffic converging from two lines,—Plainfield street and Dyer avenue, while Friendship street carries but one.

In cases where double tracks cannot be located in the centre of the street and an alternative parallel route does not exist, side track location must be resorted to, and the objections of citizens to this method of providing proper transit facilities cannot be regarded as reasonable, in the face of their demand for such facilities. It is not within the province of the railway company to determine which side of the street this location should be made.

Such side double tracking can often be avoided by means of one way loop circuits. These, however, must not cover a greater territory than convenient walking distance between the sides of the loop.

Expresses. There seems to be a decided opposition among the city residents to the development of the suburban express service. It is believed that this is short sighted and a destructive policy for the good of the metropolitan district as a whole. In transportation the problem is not defined by municipal boundaries of the settled districts. The relations between the city and the suburbs are so close, both in social and a business way, that the one cannot exist without the other. Eventually a city by expansion automatically absorbs its settled suburbs, and it is apparent, therefore, that any throttling of suburban development reacts unfavorably upon the rapid development of the city.

In Providence the expresses which have already been established are† of necessity forced to adhere to the local tracks, so that the time saved in an express run from the business district to the first suburban stop can only be equal to the prevailing local headway on those tracks. If separate routes could be found for the use of these expresses, such an arrangement would be distinctly advantageous; but no such routes exist in Providence, with the possible exception of Eddy street and Allens avenue, which are remarkably direct routes to the suburban district lying to the south.

But this necessity of accommodating both express and local service does not render it necessary to accept local business on express cars. The general disposition of the American railway patron is to take the first car that comes along irrespective of its destination or loading. This results in a heavy short haul superimposed upon the long haul load, while the entire capacity of the car should be reserved for the latter.

†See Schedule of Expresses—Table 13.

The present practice of the railway company should, therefore, be perpetuated, and the single exception thereto should be abolished. Other express lines to outlying suburbs. Oaklawn, Hughesdale and other similar points of heavy through suburban traffic should be installed to eliminate the present short haul load.

Olneyville Express Service. The time required at present to reach Olneyville is about twenty minutes. This is entirely too long for a sub-centre of such importance as a transfer point and possessing such direct thoroughfares to the centre of Providence as Broadway and Westminster street. There are three alternatives in reaching Olneyville more promptly: First, express via Harris avenue from Exchange Place loop. This service would contemplate large cars, few stops and rapid running along a street which is now comparatively unfrequented by vehicular traffic. But, in order to fully accomplish its purpose, the street should be entirely clear of local service and relieved of stops. The mileage of this route between termini is 2.13.

Second, the electrification of the steam railroad tracks from Union Station to Olneyville has been suggested. It should be noted that the question of electrification here is quite different from that of the Riverside lines now operating through the east side tunnel. The latter are entirely free from main line tracks, simply connecting at Union Station. The Olneyville electrification, however, would necessarily have to be made on main line tracks, and if such local passenger service were superimposed on such through traffic over the four tracks of the New York, New Haven & Hartford Railroad it would be but logical that the question of this electrification should

also involve that of the extension of same through Elmwood, Auburn, Lakewood and Warwick Shore resorts by way of the original steam railroad tracks connecting at Auburn. This electrification is believed to be serious enough to warrant immediate consideration with a view to meeting the future development of the district, which will become more and more difficult to handle by surface trolley lines unless a direct thoroughfare be ultimately reserved exclusively for non-stop express service, such, for example, as Allens avenue. The electrification of a short strip of main line track, such as between Union Station and Olneyville, simply for shuttle service would be questionable, except in its relation to more extensive projects.

The third alternative is to reserve Broadway for direct express traffic. Assuming the possibility of a short down-town loop via Fountain and Washington streets, the mileage between termini would be 1.62. With limited stops a schedule speed of ten miles per hour could be maintained with perfect safety, which would mean the delivery of passengers from Exchange Place to Olneyville Square in 10 minutes. These cars should be of the largest type available, and their progress should not be impeded by a large number of small, slow, single truck cars. Broadway should be known primarily as a fast line. In order to make the same time via Harris avenue, expresses would have to run on an average of 13.2 miles per hour, owing to the greater distance. Thus, the greatest advantage to be gained by the more circuitous route is largely annulled, and whatever advantage remaining will progressively decrease in the future as the Harris avenue district develops industrially.

East Side-West Side Electrification. The demand for express service to Olneyville should consistently come under the same general scope as that of Watchemoket and East Providence. Olneyville at the present time is more developed, but East Providence has the greater possibility for development and expansion. The demand, therefore, will arise for an East Side-West Side connection. If the Olneyville and South Providence roadbed were electrified this extension should be considered co-ordinately.

Those who demand electrification of steam lines do not recognize the fact that passengers desiring rapid transit might reasonably have to pay ten cents per trip to the residential district. The fare by railroad would necessarily be five cents with an additional fare over the street railway. This is brought about by the fact that rapid transit is worth more than slow traffic, and the railroad company in giving up its lines for local traffic should receive greater return in some form. The question of a possible transfer between the two systems, however, is considerably simplified by the fact that both are under the same corporate control. Such an effective co-ordination of service will undoubtedly be advantageous to the public in the future and more readily secured than if the two branches of service were under competitive management.

Trolley Freight. It appears to be the practice to allow heavy box cars carrying electric freight to pass through the congested streets of the city at any most convenient time during the day or night. Two or three of these cars have often been observed passing together out main line thoroughfares at times of heaviest street traffic. This practice should be discontinued during the rush hours. The main thorough-

fares are sufficiently congested under the best conditions without the addition of this cumbersome freight equipment and it is possible to handle this business during normal hours of the day or after seven o'clock at night without imposing any hardship upon the operating department.

Owing to the nature of the Elmwood district and the fact that the track runs so close to the walk, it is believed that trolley freights should be routed over another line. The danger incurred by accident, due to an unlighted car passing along the curb, is considerably greater than with a fully lighted car which can be seen approaching. The logical routing for this electric freight is via Dyer-Eddy-Warwick branching off through Park avenue to the East Greenwich and Riverpoint district.

As a general principle this freight routing should be, not through, but around the residential district as much as possible, even at the expense of greater car mileage. Electric freight has undergone effective development in many cities of the country, notably Detroit and Cleveland, and unquestionably is a great convenience for the transportation of light parcel or bulk freight and perishable produce. But city streets can hardly be considered as suitable roadways for the handling of heavy bulk freight. Providence should undertake immediately the development of a more suitable electric freight terminal than at present in use, providing more adequate facilities with less disturbance of street traffic.

GENERAL IMPROVEMENTS IN PLANT AND EQUIPMENT.

Synopsis: *Standard of track construction and maintenance fair. Rolling stock. Vestibules too constricted for seating capacity. Prepayment plan. Open bulkhead. Folding doors and steps. Platform 6½ feet long, possible with present overhang. Cross seats. Proposed car. Single ended operation. Trial of maximum traction trucks and semi-convertible equipment suggested. Steps. Drawbars. Heating, lighting and ventilation. Power distribution. Car houses and methods. Destination and route signs.*

Tracks. In general, the permanent way is fairly well constructed and maintained, especially on lines of heavy travel, such as Pawtuxet and Pawtucket. The present standard in use is of modern design and generally suited for the service. This standard consists of 106 lb. "Trilby" section or grooved rail with concrete sub-base extended along underneath the track in the form of longitudinal beam construction, with ties about 6 feet apart. This construction is used with asphalt, bitulithic macadam and granite block pavement, mostly in thoroughfares carrying very heavy traffic, to the extent of about 9.8 miles of single track, and confined mostly to the down-town district. The longest stretches outside are Broad-

way, Angell, Waterman and Promenade streets. For streets of lighter traffic the same rail is used but ties are spaced at 2 feet centers and laid in gravel instead of concrete. In a number of streets unpaved or of special designs, such as Elmwood avenue, T rail has been laid to good advantage with ties 2 feet centers. One instance of T rail with granite block paving on concrete and ties 3 feet centers has been permitted by the City on trial: viz., Promenade-Valley streets. T rail track on gravel is also used in connection with granite block paving, on Eddy and Dyer streets in the teaming district.

Reconstruction of important trunk lines should be carried out with this concrete sub-base or equivalent construction. For branch lines a lighter construction is suitable. In this respect, however, it is to be noted that Cranston street and Warren avenue are being reconstructed at present without either concrete sub-base or gravel ballast, simply loam packed under the ties. If the Cranston street construction is to be regarded as adhering to the standard set by the Company, it does not possess the stability necessary to handle the heavy traffic which will undoubtedly show a rapid increase. The same may be said of the Warren Avenue line, over which the heavy Riverside traffic is routed.

The standard tie plate being used is an eight-bolt "continuous" joint set between supporting ties except with concrete sub-base and with flexible "protected" type bonds fitted under the tie plate. This is good construction.

The total mileage of the present standard rail and other girder sections above 98½ lbs. is approximately 61.1 miles; there are also 7.9 miles of standard T rail, 79 lbs. or thereabouts. The balance within the City, aggregating 16.4 miles,

represents rails of either obsolete section or too light for use in an up-to-date system. Of this total, 11.4 miles is girder rail. These figures are necessarily approximate.

It is, therefore, apparent that much maintenance work remains to be done. The construction program for the present year covers 5.4 miles renewals and repairs and 1.6 miles extensions, including turn-outs, aggregating 7 miles within the city limits. Work contemplated outside of the City, but within the Union Railway Division brings the total up to 11.4 miles, 7 miles for renewals and repairs and 4.4 miles for extensions.

The special work around the system is generally of proper construction, but some of it has been allowed to get in poor condition; for example, at Hoyle Square. A detailed canvass of the lines would undoubtedly show a large number of pieces needing repairs or replacement. Special work should be the last to be neglected in track maintenance.

Corrugated rail exists at various points, and is a great source of annoyance in the residential districts on account of the noise. Typical examples are to be found at Weybosset street, curves south of Turks Head and north of Clifford, and Elmwood avenue, curves at Cromwell street and Trinity Square. The Elmwood Avenue trouble is particularly noticeable because of the location of the track so close to the building line. Where the traffic is as heavy as on Elmwood Avenue, and especially where freight service is maintained during the night, it is believed that this track should receive more attention and be kept up to a higher standard of maintenance.

Signal System. On single track lines the Company has made a good start in the installation of automatic Semaphore

signals, operated by the motorman. There are eighteen blocks of these, installed last year. The remaining signals are operated by hand, the work being assigned to the motorman, who is obliged to leave his car. He may thus lose several minutes in delay from signalling on long stretches of single track. The trial of the automatic signals is to be recommended for extension over all lines necessitating single track, reverse operation, if a type can be found that proves permanently satisfactory.

Rolling Stock.

The present schedule of cars operated into or within the City of Providence comprises three principal classes: twenty-six, thirty-four and forty-two seats respectively; some of city and some of suburban design. All have longitudinal seats except suburbans or long haul cars, which have cross seats, or combination of cross and longitudinal. Table 10.

The summer equipment consists of open cross seat cars, locally known as "bloomers," varying from forty to seventy-five seating capacity. With the exception of the suburbans, practically all cars are changed summer and winter.

Of the winter urban equipment 111 cars, or 27.8% of the total, are of the small single truck class, and a large number of them will need to be retired very soon on account of their inadequacy for heavy city traffic. This will not be so serious a matter, as they represent only 21% of the seating capacity. These small cars have been retained up to the present time because of the difficulty of operating any other type of car

over College Hill approach to the East Side, and they will continue to be required until some satisfactory form of approach is determined upon. Of the thirty-four seat class, 153 in number, these are more adequate for the service, the principal objection being the exceedingly narrow vestibules and poor arrangement of destination signs.

The forty-two seat class, comprising 73 cars, represent the latest type of equipment, 50 of them being quite new, but all having the same objection, viz., constricted vestibule. The remaining 25 cars used for suburban service are open to the same objection, but not to the same degree as for city cars.

All of the double truck winter cars have four motor equipments and with the single exception of closed cars on East Greenwich line, all cars are arranged for double ended operation. The majority have outside hung motors, necessitating somewhat greater overhang of car body beyond the bolster, in order to clear the platform, than if what is known as the maximum traction truck were used, these having only two motors per car. The principal objection here to two motor cars seems to be on the score of reduced tractive effort on heavy grades, of which there are numerous ones in the city, ranging up to 8% ; for example, North Main street at Constitution Hill, and Atwells avenue east of Academy avenue. As maximum traction trucks are operated successfully in other cities of like topography, and are especially adapted to prepayment cars of minimum possible lengths, it is suggested that a sample equipment be tried out in Providence under winter condition with the small or pony wheel outside, i. e., under the platform instead of under the car body.

Vestibules. The most serious objection to the design of rolling stock may be found in the short and narrow vestibules

which universally exist. On the older equipment the vestibules are set in from eight to twelve inches in order to provide for a step flush with the car body. Considering only the larger cars, it is found that the thirty-four seat class has a platform varying from a minimum of 4 feet 8 inches to 5 feet 2 inches in length overall from center posts, which permits a side door of only 28½ inches and a bulkhead door of 32½ inches clear when open. The new Bradley cars have 5 foot platforms, 28 inch side doors and bulkhead doors 30 inches in the clear when open.

It is apparent that the present narrow vestibules on the new cars have resulted from two things: First, the necessity of securing as great a seating capacity as possible in the car body, and second, the ordinances limiting car dimensions to 43 feet overall, but it is difficult to see why the narrow vestibules were necessitated upon the thirty-four seat class, except as a matter of tradition. Complicated by the single entrance principle, the construction becomes all the more acute as the car body increases in capacity.

Prepayment. Fortunately, the citizens of Providence have had their first lesson in prepayment—automatic registration. It is strongly recommended that the prepayment type of car should be adopted immediately. Were this an experiment the change could not be suggested with such certainty of success, but the system has been so thoroughly tried out in other cities all over the country that there is no inherent reason for its failure in Providence provided suitable vestibules are used. The fact that the majority of modern equipment now being built for urban service is of the prepayment type carries much assurance of its success here.

The prepayment idea necessitates a relatively long platform because loading capacity must be provided while passengers are receiving change. This so-called storage space increases with the size of the car body. Persons unfamiliar with the prepayment principal are apt to criticise it severely on the score of slow loading, but an essential feature of the prepayment car is the separation of the passengers entering and leaving, thereby avoiding the interference which is the source of so great delay in the single entrance type of car. With the present narrow platform it is a fact that the average time of loading per passenger is fully equal to if not greater than the time required for the prepayment type, both under rush hour conditions. Fig 12.

There are two types* of prepayment cars. In the first, termed the "Pay-as-you-enter," the conductor stands just outside the bulkhead within a small railing pocket and collects fares from passengers before they enter the car, either by hand or by fare box, also assisting the passengers as they enter and leave by separate paths on the rear platform. This type is universally equipped with bulkhead doors, usually double doors sliding into a short centre bulkhead back of which the conductor stands. In the second type known heretofore as the "Pay-within," the bulkhead is removed. The conductor stands in the center of the bulkhead line collecting fares in the usual "pay-as-you-enter" manner. An important feature is a sliding or folding side entrance door which is also equipped with a hinged step which drops when the door is opened and raises when it is shut. In both types the principal exit is forward, but both are usually provided with a small rear exit for the use of those passengers detained in the rear of the

*See note on "Near Side" Car—Page 239.

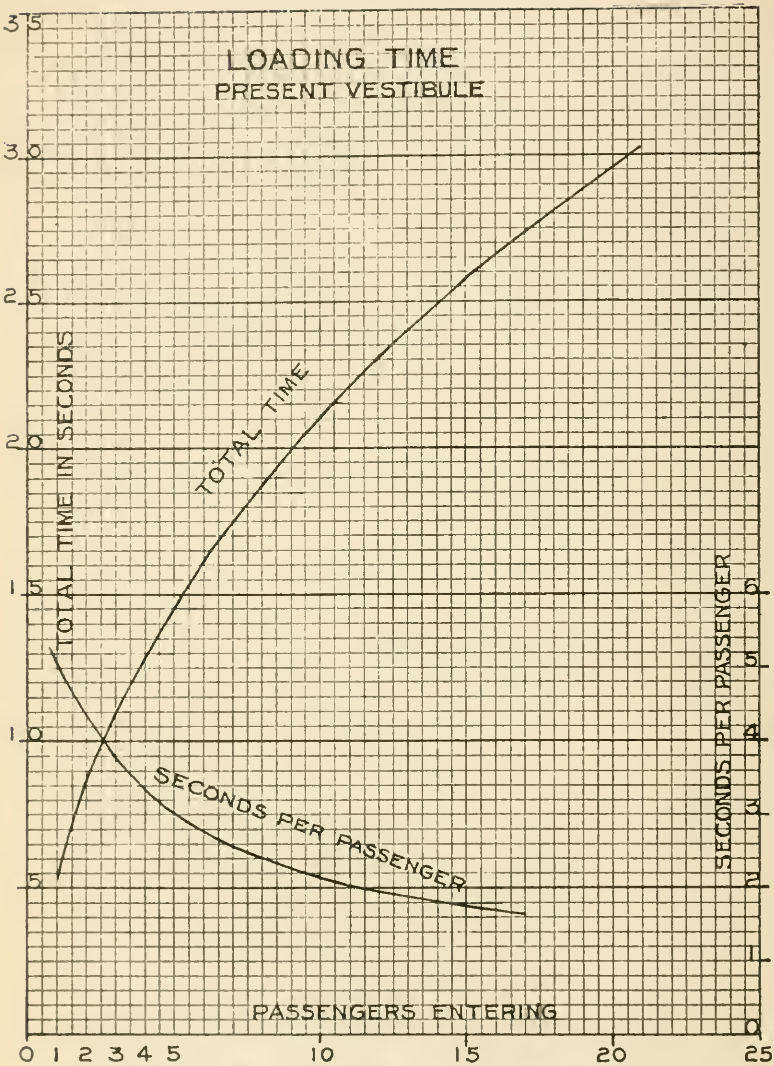

FIGURE 12—LOADING TIME, PRESENT VESTIBULES.

Diagram representing results of observations in Dorrance street on a large number of passing cars. Note that the time required, per passenger, decreases rapidly with the number up to about ten passengers entering the car.

Illustrating
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FIGURE 1[illegible] TYPICAL PREPAYMENT CAR

Illustrating the prepayment vestibule proposed for Providence. This car also illustrates [illegible] traction truck, reversed with pony wheels located well forward under platform. Entrance [illegible] the rear [illegible] forward. Both doors and steps operate mechanically and remain closed when car is in motion. Open bulkhead [illegible] and [illegible] The lower detailed views show rear doors in open and closed positions respectively, with folding step [illegible]

car when crowded. The front "Pay-within" door is also operated in conjunction with a lifting step, and both may be worked either by compressed air or mechanically by the conductor and motorman. If air is used positive means should be provided for releasing the air pressure from the closing cylinder, so that passengers could open the door in case of emergency.

The open bulkhead or "Pay-within" principle is to some extent favored for the reason that it is best suited to the present fare collecting system now fully established on the Providence lines, and in this respect allows much more so-called loading space in the prepayment platform for incoming passengers. Stationed just at the entrance to the car body, the conductor also has much more latitude in receiving passengers than if stationed outside behind a bulkhead. The "Pay-within" car was developed to suit conditions identical with Providence—narrow streets, and sharp curves. Its automatic door and step practically eliminates accident to passengers and encourages prompt schedules. A typical car of this type is shown in Fig. 13.

Some objection has been raised to removing the front bulkhead for the reason that motormen open front windows for switching and that frost would make it impossible to see clearly ahead. With electric switches at important points the opening would be unnecessary, and even now it is by no means generally resorted to. In open bulkhead cars the temperature within generally keeps the windows clear of frost. The temperature record here does not indicate unusual severity of weather not encountered in other cities using open bulkhead cars.

In case, however, it is necessary to provide a closed vestibule for the motorman this can readily be done without the use of a bulkhead by arranging separate extension doors to surround the motorman only. These will be folded back in place when not needed.

Platforms. These prepayment platforms vary in length from 5½ feet on the smaller cars to over 8 feet on the larger, as, for example, on the Chicago Railways. The latter length, however, was provided to suit the demands of peak loads in a very large city and would not be applicable to Providence. Moreover, Chicago cars are equipped with cross seats so that the maximum loading space was desirable. With longitudinal seats the greater standing capacity lessens the necessity for loading space on the platforms.

These long platforms might be regarded by some as impossible for the Providence streets, but it occurs that by tapering the platform from bulkhead to bumper the overhang at the bumper in rounding any curve may be no greater or even less than with a shorter platform of rectangular proportions now used. It is, therefore, clear that the length of the platform is not the criterion by which car proportions should be subject to regulation, but rather the overhang in rounding curves. Furthermore, it is not the inside overhang of the car body that is serious from a standpoint of accident, but that of the rear platform when sweeping around a short radius curve. The overhang of the car body at the curb will simply result in sweeping aside a careless person without injuring him, while a vehicle caught by the rear platform would be crushed.

Overhang. Overhang involves five factors: Length of car, radius of curve, taper of platform, distance between

truck centers, and type of trucks. It is desirable to increase the truck centers as much as possible in order to increase the end overhang. But a limit is reached with outside hung motors in clearing the platform underpinnings. With maximum traction trucks reversed, with pony wheels forward, it is possible to locate the truck centre 1 foot or more forward, and thus reduce very materially this end overhang. This, however, requires two-motor equipment. Spreading the truck centres, of course, increases the inside overhang.

As the radius of the curve decreases rapidly on a narrow street there must be a careful adjustment of curve radius in order to form a balance between inside and outside overhang. In a choice between the two it would always be preferable to lengthen the radius, thus bringing the curve nearer the curb, but increasing the clearance from curb to car step. Clearance studies of varying curve radius and truck centers show that for the present cars a 37 foot radius curve is a reasonable minimum. Below this radius the overhang increases very rapidly and should be avoided in Providence.

Car Studies. In order to form a comparison of proper proportions best suited to the conditions of Providence, we may take as a starting point the overhang of the present rolling stock, both winter and summer. Many years of experience have been acquired with this equipment, and moreover, the public is used to it. If, now, we can design a car combining the desirable features and not exceeding the overhang of the present car, there should be no reason why such a modified design would not be acceptable.

The result of preliminary studies may be summarized as follows: assuming present platform replaced by prepayment platforms.

Car body—present Bradley body 31 feet over corner posts; width over drip rail 8 feet 7½ inches.

Platforms—prepayment 6 feet 6 inches overall, tapered to 6 feet 6 inches width at bumpers.

Truck centers—same as at present, 19 feet 6 inches, four motors.

This car is shown in the clearance studies, Plates IX, X, for a forty and fifty foot single track street and for a sixty foot double track street, the minimum for double track operation. The outside overhang on the proposed platform is found to be no greater on a 37 foot radius curve, practically the sharpest encountered. The overhang at rear platform of the present box car is practically the same as the largest bloomer cars with standard truck centers, while the inside overhang of the bloomer is slightly greater than the box car, even with the inside running board lifted.

The composite templates, Plates IX and X, shows the bloomer floor plan at one end and proposed prepayment car at the other. Assuming a 37 foot radius curve there is found to be 7 feet 10 inches minimum clearance to curb for the fifty foot street, and 4 feet 10 inches for the forty foot street. The one will accommodate passing vehicles of average width, 7 feet, without danger of pinching against the curb, while in the forty foot street a vehicle must stop as at present at least 10 feet back of the corner until the car passes around the curve.

It is clear from a study of clearance with various street widths later discussed† that the minimum width of roadway on a street, much frequented by vehicles, should be 36 feet

† See Plate XIV.

for single track, or 60 feet width of street. With a 50 foot street, such as Fountain street, ample clearance would be available on a tangent for a vehicle even 8 feet wide. However, the fact that Fountain street is reached at an oblique angle at both ends and not at right angles, decreases materially the platform overhang as a longer radius curve may be used.

For double track lay-out, it is necessary to spread the track at the curve in order to provide sufficient clearance for cars to pass in both directions without interfering. This necessitates a curve of small radius for the outer track, which has been taken at 37 feet and as large a radius for the inside track as possible. The point of maximum overhang occurs about opposite the beginning of the curve, and by locating an easement on the inside track, either in the form of a spiral or a compound curve running off into long radius, sufficient clearance can be had between the two lines of cars for safe operation. In this lay-out for 60 foot street the template shows the present bloomer car at one end and the proposed prepay platform at the other, for which the overhang is the same. With a 37 foot radius curve on the outside, and the inside curve compounded to 35 feet for a portion of the curve, we have two important results: First, that cars may pass on the curve without interference, and second, that no overhang of car body is over the curb. This is considered as good a result as can be expected for Providence conditions. It will not allow a vehicle to pass while a car is rounding the curve, but gives ample space for four-line traffic along the tangent.

Seating Arrangement. A 31 foot body has been considered in order to demonstrate the possibility of modifying the pres-

ent equipment by lengthening the platform. The present bodies with longitudinal seats are classed as forty-two seats allowing about 17 inches per passenger average spacing, which is not liberal. The car would seat forty people with 18 inch spacing, or if cross seats were used in double ended operation.

There is no question but that the best practice contemplates the use of cross seats. The Rhode Island Company advocates and uses cross seats on its long haul suburban lines. It regards a longitudinal seat as practically essential for short haul business. This is due largely to the absence of the prepayment principle which makes it necessary for the conductor to force his way through two lines of standing passengers for the collection of fares. With prepayment there is no reason why cross seats cannot be used with the same degree of comfort as the present longitudinal seats.

In the accompanying studies, Plate XI, a number of seating arrangements are shown for cross and longitudinal seats or combinations.

Type A is the present car with a prepay platform at the rear and the present platform at the front. This would be suitable for single ended cars. Type B shows cross seats on one side only. Type C shows an arrangement of half cross and half longitudinal seats, symmetrically arranged for double ended operation. Type D shows six pairs of cross seats. Type E shows all cross seats, Type F the same for single ended operation. All of these cars are based upon the present Bradley body which has a window spacing 32 inches, the same as the seats. With 33 inch seats an aisle space of 27 inches in the clear is provided. In Type C the most constricted point in the car is 36 inches, nearly the width of

the aisle. This type may be regarded as a compromise between long haul and short haul accommodations. All of these cars will seat forty passengers comfortably. Assuming ten standing passengers on the platform, the maximum passenger capacity is as follows:

Type	A	B	C	D	E	F
Seated	40	40	40	40	40	40
Standing	40	36	30	25	15	25
Total	87	76	70	65	55	65

For single ended operation Types D & E will seat two more passengers, or four at a maximum.

Proposed Car.

Type F shows a modified design, car body 8 feet 6 inches wide overall. With modern steel girder or composite construction and raised sashes, it is possible to utilize the hollow sides between window posts for accommodating the metal fixtures of the seat, so that with 33 inch seats an aisle space of 31 inches can be obtained, or with 36 inch seats a 25 inch aisle, the dimensions of the latest Chicago cars. In this car the window spacing has been reduced to 30 inches, and with a body 30 feet 9 inches over corner posts forty seats can be accommodated, allowing 19 inches per passenger on the longitudinal seats. For single ended operation four additional seats can be used, giving a maximum car capacity of 69 passengers. An advantage of this combination arrangement is that it allows 8 feet at each end of the car for two or three rows of standing passengers, reserving the center of the car for long haul seated passengers.

Single Ended Cars. The question of single ended vs. double ended operation is important. By some the latter is favored for the following reasons: First, because double controller equipment provides a reserve against breakdown; second, that in case of obstruction along the track a car would not have to back with the motorman at the rear end; third, that loops or Ys would not have to be provided at the outer terminals. The first objection is believed not to be serious. Second, even with double controller, the car would have to be operated from the rear end if the forward controller should be disabled. As to the third objection loops or Ys on important lines cannot be regarded as a hardship. More rapid loading may also be accomplished at outer termini at times of congestion, such as parks or main streets of outlying centers. The arrangement is of maximum benefit on urban lines of heavy traffic, at least on long haul interurbans. The East Greenwich line is now operated single ended satisfactorily from the above standpoint. Single ended cars might well be used on the more important loop lines, such as Pawtucket and Pawtuxet, and at heavy loading points, such as Rocky Point and Crescent Park. Some of these outer terminal loops already exist; inner terminals are already provided. The principal advantage is the gain in seating capacity and the clearing of the rear platform of obstructions for the better accommodation of the incoming passengers.

Alternatives. The alternatives in regard to the present equipment are as follows: First, retain the present Bradley car with platform, and pass all passengers in at the rear and out at the front, for double ended operation; second, same as above, except clear rear platform for single ended opera-

tion; third, retain front platform with bulkhead and extend rear platform to prepayment, single ended operation; fourth, remove both bulkheads and install folding doors and steps operated by the conductor; fifth, extend both platforms and remove both bulkheads, double ended operation; sixth, same as the fifth, except for single ended operation.

The first could only be regarded as a makeshift. The second little better than one. The third and fourth would be a considerable improvement. The fifth and sixth, a great improvement.

The cost of these changes would be about as follows: By using the "Pay-as-you-enter" plan with center bulkheads with split corner posts and using the present doors, about $425 per platform; removing the bulkheads entirely and using four-leaf folding doors on the "pay-within" plan, the cost would be about $500 per platform. In each case the canopy would be spliced and the platform sills reinforced by steel angle stiffeners.

Comparative Size. To illustrate the relative size of the proposed car and the prepayment cars of other cities, several typical car bodies have been superimposed in plan, Plate XII. From this it will be apparent that the length of platform and taper herein suggested is not unreasonable.

Steps. Objection has been made to the heighth of steps on the Providence cars. Considering the three most important types, these are shown in elevation on the composite diagram, Plate XIII. With a standard 33 inch wheel the car floor is about 40 inches from the rail head, and the platform about 30½ inches. The first step from the ground is about 15 inches to 17 inches, leaving the second step 14 inches

to 15 inches. One of the present cars, a thirty-six seat suburban, has the first step 18½ inches, which is too high.

The height of the second step is practically regulated by the permissible drop in the platform, this, in turn, by the clearance of fender trip and motor and truck clearance. With four-motor equipment and outside hung motors a drop of eleven inches seems to be all that can be secured and clear the platform without shortening the truck centers, which would, in turn, increase the platform overhang. On the present car 9 to 10 is the maximum. A greater drop would require different car framing—practically necessitating new cars.

The composite diagram, Plate XIII, shows similar proportions of recent equipment for various other cities; the floor height is about the same. The platform drop is less in some cases than in Providence, but increases to 11 inches in Chicago, where, however, overhang was not so serious a consideration. The platforms in all of these cars were about 30 inches from the rail, the same as the new Bradley cars, but the first step is a little higher and the second a little lower than in Providence. A second step of 14 inches is, therefore, not considered unreasonable.

Objection is made to cutting in the platform in order to moderate the steepness of this second step and still keep the step flush with the side of the car. To avoid this, the whole vestibule of the present cars has been contracted the full width of the step tread. With the prepayment platforms this contraction becomes unnecessary, and the step can be slightly tapered at its extremity, so as to give maximum platform width and yet not extend beyond the car body. With folding steps this question is immediately simplified, for the entire

width of the platform can be retained as the step is out of the way when raised. The foregoing photographs. Fig. 13†. of a recent car of this type will illustrate the point. This also illustrates how the four-leaf folding doors operate as a guide or buffer to prevent passengers from injury.

Semi-Convertible Cars. The duplication of investment in rolling stock now necessary to provide open cars for summer represents a drain upon the earnings of a railway system that it should not be called upon to bear. This extra investment means less service and vice versa.

To avoid this the semi-convertible car has been developed, in which the sides are removed during the summer, thus giving practically a center aisle cross seat open car. With prepayment platforms and automatic doors and steps the greatest source of accidents is removed and higher schedule speed made possible. The demand now being made for a center aisle summer car can be entirely met with the convertible car. Remodelling of the present equipment is difficult on account of the absence of drop platforms, but new equipment of this type could be easily introduced gradually as the old cars are retired. It is recommended that in all future prepayment equipment this convertible feature be incorporated.

Fenders. The fenders on all of the city cars are of the wheel guard type, located entirely under the platform; some are tripped automatically, others by the motorman. Suburban cars entering the city have, in addition, projecting fenders, but are required to raise them while in the city. Owing to

†Insert, Fig. 12, opposite page 111.

the narrow streets it is practically impossible to use a projecting fender, as the sweep would be altogether too great a source of danger and impedance to vehicle traffic. The wheel guard type fender is effective on large double truck cars, but on single truck cars the platform is somewhat lower and the present draw bar rigging as used in Providence offers a pronounced obstruction to its effective operation. On some of the larger cars the clearance from street to draw bar support largely obstructs the fender trip and leaves entirely too little space underneath the platform for an effective safety appliance.

Drawbars. The drawbars and supports can be completely eliminated by providing a permanent socket underneath each platform and single drawbar carried on each car to be used only when needed for coupling cars together, for going up College Hill, or for the purpose of allowing a car to be pushed in when disabled. If this plan were adopted, the trips of the present fenders would then be effective in their present position.

Grab Handles. Additional provision should be made for enabling passengers to prevent themselves from a fall during acceleration or braking. If cross seats are adopted a small grab handle can be fitted to the corner of each seat. On the platforms a simple vertical stanchion at the entrance might serve the double purpose of providing a support for the passengers getting on and off, and also to divide the passenger movement in the same way as a bent pipe railing. In case the four-leaf folding doors are used with a prepayment platform, it is desirable that grab handles should be available on the inside of the doors when it is in open position. In some

types of folding doors such as used on the new cars in Pittsburgh the handles fold inside. It is essential to have grab handles of some kind to assist passengers up and down the steps.

Bells. Every car should be equipped with electric bell signals. In the new Bradley cars the conductor is signalled by a buzzer and in turn the motorman by bell. This distinction in signals is desirable. The other cars can be similarly equipped without great expense, and this should be done during the present season of overhauling.

Ventilation. On the old cars the ventilators are of the old pivoted sash type. The latter cars are similarly fitted, but with stops. A radical change in ventilators could hardly be prescribed for present equipment, but with all new equipment any of the several deflecting or curved types of suction ventilators are recommended, or other type which will provide positive ventilation at all times (with car in motion) at the rate of 350 cubic feet per minute per passenger.

Lighting. The lighting arrangement in the new Bradley cars is of a high order. Much of the criticism of lighting in the older rolling stock is due to the use of exhausted lamps of deficient candle-power. To be sure, the voltage on some of the longer lines drops to 400 or below at times, but the more frequent renewal of lamps is such a small item of expense as compared to the satisfaction to the public, that the use of old lamps should be discontinued at once.

Headlights. It is the practice on some interurban cars entering the city to keep their arc headlights under full power. This has caused considerable justifiable complaint, because of people being blinded by the light. This difficulty can be

overcome either by shutting off the head-light or drawing a muslin curtain over the disc, as is done in other cities. The former deprives the car of head-light, while the latter sheds sufficient light along the roadway for city purposes and entirely avoids the complaint. Another method would be to place a slanting deflector over the disc within the city limits, designed to throw the light downwards on the street.

Front Exit. In the present cars it is the practice of many motormen to lock themselves in the front platform and pull the curtains down, except the one at the right of their vestibules, prescribed by the rules of the Company to be left open at all times. This practice, no doubt, grew out of the policy which prohibits passengers from leaving by the front platform, but it should be discontinued as a source of danger. Accident to the motorman at a critical time might result in grave consequences. Moreover, the front passageway should be at all times clear in the case of emergency, whether this is done in ordinary operation or not. In some of the cars the door lock has been carried through the frames, so as to be operated by persons inside; this is a recognition of the above difficulty. In the event of the prepayment idea with front exit being adopted some method must be devised for shielding the motorman from the light without closing the opening with a clumsy curtain. In open bulkhead cars this has been accomplished by a curtain about 30 inches wide pulled down at the motorman's back, guided by two vertical pipe stays. The rest of the car is brilliantly illuminated. These seem quite as satisfactory for city work as a completely darkened vestibule.

Heating. Modern practice is tending toward a combined system of indirect heating and ventilation, the air being drawn

in on electric heaters and drawn out at the top of the car by means of the ventilators above mentioned. The distribution of heaters for the present cars is as follows, based on 500 volts potential:

Standard Bradley—12 heaters—11.5 amperes—3 steps.

34-seat class—variable 10-12 amperes.

Whether this equipment in all respects is ample for above conditions can only be determined by actual tests. The heating capacity seems to be sufficient for present normal operation if it is fully used. For the past five years the average temperature in December to February was 27.0 degrees F.; average lowest temperature 2.7 degrees F.; minimum recorded, 4.3 degrees below F.; average number of days below 32 degrees F. 114; total number of days in ten years below zero, 13.

Cushions. Rattan has been adopted by the Company on new equipment in place of plush. This is to be regarded as an improvement in the direction of sanitation.

Power Generating Capacity.

The present generating capacity of the Manchester Street Station is 16,300 K. W. Assuming a maximum overload capacity of 50%, which is probably reasonable in view of the fact that one of the large machines is a steam turbine, this gives a maximum station capacity of 24,300 K. W. The maximum peak load during December was about 19,000, which gives a margin of overload of slightly over 20%. This is fair, but does not provide for much reserve equipment. However, the power is well split up into three alternating current units

and nine direct current units. The maximum load during two typical days in March was 11,000 and 13,000 K. W. respectively, including power sent to the five sub-stations.

Copper Distribution. Trolley voltage tests taken during the rush hour at thirty-six different points around the system generally most distant from the generating station show the voltage running as low as 320 volts for short periods, 360 volts for periods of several minutes duration, and ranging from these low points up to full generating voltage, 600 volts. The great majority of tests show in the neighborhood of 400 to 450 volts. Some of the low lines were those depending upon trolley alone for current distribution; for example, Dyer avenue and Smithfield avenue. Broadway also depends upon trolley distribution, although fed from both ends. Chalkstone and Academy avenues were low, although separately fed up to the intersection. Manton avenue is also low due to the long haul. The East Side lines depend to a considerable extent upon trolley copper, but they are not so heavily loaded with large cars.

This low voltage in so many places indicates that additional copper should be installed if the system were to continue to operate as at present.

To determine the proper amount of copper for the overhead distribution would involve much calculation† and extended car tests. This is considered unnecessary at the present time, as the changes in routing and service will change the distribution materially. When a definite program of improvements is determined upon a recalculation of the copper should be

† For such a study the car location Map Plate XX furnishes a proper basis.

made. This applies particularly to negative copper returns designed to reduce electrolysis, concerning which reports have already been made to the City.

Sub-Stations. It is not possible to consider in detail in this report the economics of direct current vs. alternating current transmission for the entire district, as such a study would require elaborate calculations. It is, however, apparent that the present practice of the Company in regard to location of sub-station at outlying points might well be gradually extended. The heavy traffic centered in Olneyville suggests that a sub-station at this point might result in a considerable less drop in voltage by serving lines west of the square from Cranston to Centerdale, also assisting the Chalkstone avenue and Smith street lines by feeding back. But whether this should be accomplished by means of a sub-station or by additional direct current copper is a matter for engineering determination by the Company. One of the longest single transmission lines at the present time is to Centerdale and Enfield, the distance being approximately 7 miles from the power station. As the suburban development to the south increases a sub-station might be found desirable in this vicinity.

Car Houses.†

The latest construction work of the Company, as represented by the Thurbers avenue, Academy avenue and North

† Schedule of car houses—Table 14.

Main street car houses, is commendable in many respects, also the Elmwood avenue car house and the Cranston repair shop. The Hartford avenue barn is next in order of adequacy, then Traverse street, and finally Arlington, which is the least adapted to modern conditions. Two of the old horse car barns are in existence, but have now been abandoned, one on the Branch avenue line at Geneva, and the other at the corner of Chalkstone and Academy avenues, except for storage.

The Company's present standard of car house involves the following: Brick walls; Monitor type mill roof; concrete floors; automatic sprinkling for fire protection, with supplementary power reservoir system. Approximately half the barn is used for the storage of cars, separated by brick fire walls; the other half is built with open inspection pits and hydraulic motor lifts, this arrangement permitting the cars to be cleaned by the regular cleaning force at the same time that the motor and truck equipment is being inspected and repaired.

All of the barns are single end design; that is, cars are run in and out on the same tracks. The best modern practice differs from this arrangement, in that it permits of the cars to be run in one end of the barn and out at the other, being cleaned, inspected, and repaired on the way. The objection is made here that at none of the locations will the levels permit of double ended barns. However, it is quite probable that levels can be found or created in the future to suit this design. For example, the Hartford avenue barn parallels Hartford avenue, and by the purchase of abutting property at the rear a double ended barn could be created. At Thurbers ave-

nue the difficulty in the levels prohibits double ended operation, but at the Elmwood avenue barn the rear car house yard is filled with storage tracks with a flush transfer table now unused. Here the double ended system would now be possible.

At the older barns with dirt or wooden floors there are unmistakable evidences of lack of modern cleaning facilities. Concrete floors are necessary to permit cars to be cleaned where they stand, if necessary, with a hose.

Car House Standards. By the Company's statement, every car on its system is run in every 500 miles for thorough inspection of trucks, motors, trolley stands, brakes, controllers etc. Gear cases are opened twice a month. Cars are swept and dusted, windows washed and commutators sanded each daily run-in. The entire body is washed each 500 miles turn-in. Car bodies are painted every two seasons and varnished every season.

A 500 mile turn-in in regular service corresponds to about 3½ days interval, or on some lines twenty round trips, such as Buttonwoods.

It is impossible without an extended examination to report definitely whether this standard is maintained in all car houses. The standard is fairly reasonable *if maintained*, although the standard in some other cities is better. The facilities at the more modern barns would unquestionably make it possible of attainment, but there is little doubt that from lack of equal facilities at the other older barns, and the evident condition of the cars as sent out each day from these particular barns that the standard is not maintained. The Company reports

that the cleaning and repair force this year is practically the same as in 1907. For the additional equipment that will reasonably be required, it is, therefore, recommended that the Company improve its car house facilities at the earliest possible date.

The Hartford avenue car house could easily be remodelled at no great expense and converted into a double ended structure. The Arlington Barn could be abandoned or entirely rebuilt, possibly in connection with the Cranston street repair shop. The Traverse street house is not suited for city cars and, in fact, not used, but located on the south shore trunk line it can be utilized to good advantage as a supplementary East Side repair shop.

New Car House. It appears that either now or in the very near future a new car house will be required to serve the lines of the third ward. Owing to its isolation by the Blackstone River, the North Main street house is not readily available for the Smithfield avenue, Charles street and Branch avenue lines without incurring considerable dead mileage. For the same reason the Academy avenue barn is not available for these lines because of the absence of cross lines. It seems, therefore, that a car house located in the vicinity of Leonard's Pond, for example, on Hawkins street, could be used to excellent advantage to serve the following lines: Smithfield avenue, Woonsocket, Branch avenue, Charles street, Douglas avenue and Admiral street, especially if the last three lines, all of which are through-routed, should put in here on their last outbound night trip, as discussed elsewhere under Re-routing.

With the development of the East Side a barn will also be ultimately required* at or near the Six Corners in East Providence.

Repair Shop. The facilities of the repair shop on Cranston street seem to be of a high order and ample for the present system and also for any modification of the present rolling stock in regard to platform arrangement, etc., so that the Company should have no hesitancy in taking up this work in rotation only on the score of the cost.

Destination Signs.

The system of signs at present employed should be very considerably modified to obtain the results desired, and apparently the Company is willing to accede to any reasonable demands. One of the difficulties it has encountered is the lack of unanimity of official opinion regarding the type of sign most effective. It is understood that the side signs, generally designating routing, were removed by petition, and that now equally great objection is being found to the new cars for having no side signs, these having been left off by the Company until a scheme could be devised satisfactory to the majority of the riders.

Much criticism has been directed towards the dashboard signs on account of the difficulty of reading in the glare of the head-lights. This criticism is just and it is recommended that dashboard signs be entirely abolished and that transpar-

* The question of most economical cost and location of course should be worked out in detail by the Company's Engineers.

ent illuminated signs be exclusively used. This leaves three location for signs: First, head sign; second, rear sign; third, side sign; all of which should be located near the top of the car. Discussing these under three headings, i. e., single routes, through routes, expresses:

For single routes, head signs should indicate destination exclusively in any of the following ways: First, by sub-center of population, such as Arlington, Olneyville, Auburn, Edgewood, Pawtuxet, Pawtucket, Manton, Broadway, Six Corners. Second, by a manufactory, such as Cranston Print Works. Third, by the last important street traversed, such as Union avenue, Smithfield avenue, etc. Rear signs should also designate destination, but in the case of a single route looping in the city the principle loop should be designated, such as Market Square, Exchange Place, Turks Head, Dorrance street, etc. Side signs should indicate routing exclusively, except in a few important cases mentioned later. For a single or loop route the word VIA would be a simple designation. The side signs should indicate: First, important streets traversed, thus for the Centerdale line, VIA MANTON AVE.—WESTMINSTER ST. or VIA SMITH ST., the outlying street being always mentioned first. Second, special cases where thoroughfares are not of sufficient distinction, or the route is excessively long, the destination as well as the routing might be used on the sign side, such as CENTERDALE VIA SMITH ST.

For through routes, the same general scheme should be used as follows: Head and rear signs designating destination exclusively; thus OLNEYVILLE for the Olneyville-Rumford line; side signs indicating routing exclusively, using

hyphenated term instead of the word via attached to all single loop lines. The end signs should both indicate localities as far as possible, but in the absence of distinct names streets must be used. On the other hand, the side signs should indicate routes, not localities, thus, the line running from Olneyville to Rumford should be known as the OLNEYVILLE-RUMFORD LINE, not Broadway-Rumford, head and rear sign reading RUMFORD, side sign BROADWAY-COLLEGE HILL or RED BRIDGE in distinction to Washington Bridge or Taunton Avenue. Again certain exceptions have to be made, such as on the Eden Park-Camp Street line, where Auburn is a suburb, but would not be distinguishable by using Pontiac avenue as the designating terminus, for the reason that the Pontiac line runs many miles beyond.

Inbound Cars. For single loop routes inbound side signs need not be changed and end signs should be reversed. For through routes the signs are not to be changed while going through the centre of the city, but run to the other outlying terminus, when the end signs need only be reversed. There is some weight in the argument that it would be desirable to have a dash sign indicating what part of the business section the through route traverses—thus, Market Square or Exchange Place—but it is believed that the complication and difficulty resulting would more than offset the advantages.

Expresses are now designated correctly, except that the first stop should be indicated on one of the illuminated signs; thus, head and rear sign should read BUTTONWOODS EXPRESS, sign at side reading EXPRESS VIA ELMWOOD AVE., FIRST EXIT STOP PARK AVE., inbound LAST ENTRANCE STOP PARK AVE.

Type of Sign. The roll type illuminated sign may be recommended for future use, because it has the advantage of being seen from inside as well as outside the car. If it is decided to lengthen the platform of these 34 seat cars to accommodate the prepayment principle, advantage could be taken during the change to install transparent roll signs. But it would be unreasonable to require the Company to discard the signs on cars that are rapidly becoming obsolete.

Much criticism has been directed towards the use of the CAR FOLLOWING dash sign in case of trippers sent out ahead of regulars to relieve the latter of the excess rush hour load, or in the case of double or triple headers where cars are sent out to pass through the turn-out together. In both cases the cars are supposed to stay together somewhat in the form of a trailer as used in other cities. So far, the use of the CAR FOLLOWING sign would not be objectionable, if it were installed as a transparent sign in the window of the motorman's cab, but it almost invariably occurs that at some point of the route these cars become widely separated and in some cases the signs have been in place through negligence, when the car actually following has been turned into the barn. This separation is a frequent occurrence, and either of these conditions produces just cause for exasperation. It is suggested, therefore, that the CAR FOLLOWING signs be taken down when the car designated has dropped back so far as to be out of sight of the conductor. It should rest with the conductor to notify the motorman to remove this sign or put it in place. On congested streets the two cars should be considered as separated when more than two cars of other routes have intervened in the line of traffic.

CO-OPERATIVE CITY PLANNING.

Synopsis: Traction improvement plans require City co-operation. Thoroughfares widened or created. Constitution Hill. Randall Street. Mathewson-Snow-Aborn Streets. Fenner St. Fountain St. Fulton St. Steeple St. Winter-Lockwood-Point Sts. Maryland Ave. Smith St. Chalkstone Ave. Plainfield St. Economical street widths. Offset track location necessary for double tracking. East side approach must be executed. Alterative plans. Shelters. Trunk lines for express and freight. Studies in City planning suggested.

For any permanent and effective result to be accomplished by the present plans for traction improvement, the City must offer prompt and hearty co-operation. By itself the Company is obviously helpless to accomplish adequate results, and the usual public attitude of distrust, which regards any concessions by the City as simply additional corporate gain, will defeat the purpose of such plans. The civic questions involved are of such vital importance to the wholesale development of Providence that they should be given detailed consideration by a technical Commission on the City Planning, as in other cities. The recent report of F. L. Olmstead to

the Pittsburgh Civic Commission is an excellent example of the profitable results of such a study.

Thoroughfares.

It is regarded as essential to a thorough and effective re-routing plan that certain thoroughfares should be opened for railway transportation, and that the necessary modification of the present ones be carried out promptly. In no way can the City derive greater benefit in the end from the comparatively small expenditure necessary for these improvements than by making it possible to effect an adequate re-routing plan. If the City is unable to do its share in this work such a plan becomes practically an impossibility. The appended list discusses improvements most needed without question as to detailed cost, which would benefit the business district for many years to come, and ought to be carried out at once. The suggestions herein can only be incidental to the consideration of the traction problem, whereas the broader question of thoroughfare revision ought to be placed in the hands of such a City Planning Commission.

It is not within the province of this report to determine the practicability or cost of improving thoroughfares, but there are certain projects that should manifestly receive serious consideration, and these are briefly commented upon.

Constitution Hill. Outbound cars on North Main street are regularly held up at Constitution Hill often as much as two minutes, to permit the descent of Auburn-Camp Street cars via Olney street. This results from a single track up

the hill, as the present roadway will not permit double tracks. Such a condition of counter-travel operation is intolerable upon a main thoroughfare. Furthermore, at the intersection of North Main and Mill streets there now exists a sharp reverse curve necessary to route North Providence cars through the Mill street entrance. This is an extremely important intersection for both street car and vehicle traffic, and the impediment to traffic is serious, owing to the extremely sharp angle between property lines at the foot of Constitution Hill.

The width of the roadway at the foot of Constitution Hill is 32 feet, ascending the hill, 27 feet, at the top, 24 feet, thence varying from 25½ feet to 32 feet at Randall street. The character of buildings is such as to render the cost of widening extremely low. It is, therefore, suggested that the western building line of North Main street be set back at least 6 feet and the curb widths north of the hill made regular, in order to preserve at least a 30 foot roadway.

The west side should be widened for the reason that the east side is already in alignment with the North Main street thoroughfare, and particularly for the reason that the diagonal width at the entrance throat to Mill street would be increased some 15 feet to 20 feet, and thus preserve an unobstructed way for vehicles between track and curb on *both sides* of the street.

It is believed that, whether Constitution Hill is used for single or double track car traffic, it is a sufficiently important street to have this work carried out while it is possible to do so at low cost. At least, the present congestion must be

relieved and the cutting off of the corner of the present triangular plot north of the throat would be only a makeshift.

Randall Street. As an easy grade outlet to Pawtucket, Randall street is superior to Constitution Hill; as, in the case of the latter, Randall street can be widened now at very little expense. Moreover, it centers in the intersection of Randall Square, which will then become a transfer point for a number of radiating lines. It is believed that this fact and the easy grade constitute a preponderance in favor of the Randall street widening, if both can be made at once. However, both are essential to the City's development. With cars routed via Randall street, Constitution Hill would be left fairly free for automobile traffic and light hauling, owing to its directness, which would at the same time relieve Mill street of some of the interfering traffic.

Mathewson and Snow Streets. The widening of the curb by a few inches, or even a foot, cannot be regarded in any sense as adequate to meet the demands of the present situation on Mathewson street. In a satisfactory down-town routing scheme a wide transverse street is urgently needed between Washington and Weybosset streets trunk lines for the purpose of completing outlying track loops. Owing to the commercial development of Mathewson street an actual widening of the street to permit of a minimum roadway of 36 feet necessary for double tracks would be expensive. Snow street has, therefore, been suggested as more feasible and less expensive, because it is not yet as fully developed. On the other hand, Snow street does not provide a clear transverse thoroughfare from the West Exchange street warehouse dis-

trict, but this might be of some advantage in leaving Mathewson street clear for through vehicle traffic.

Intersection of Broadway-Atwells-Aborn. These streets form one of the most important outlets from the business district. Although Washington street is double-tracked, owing to the existing 24 foot curb on Aborn street, it is impossible to route cars directly from Washington street to Broadway and Atwells avenue, except by single track. This necessitates a diversion of outbound Broadway traffic through Jackson street, and of Atwells avenue traffic through Federal street and Bradford street.

Here are three important converging streets, one of them the widest thoroughfare in the City of any considerable length, with an outlet only 23 feet between curbs. It is apparent, therefore, that Aborn street should be immediately widened from Atwells avenue, at least from Washington street to both Atwells avenue and Broadway, thus eliminating the undesirable single track detours now necessary.

This project possesses another important aspect: The City badly needs a thoroughfare leading from the west side through to Weybosset street, and there reaching the important distributing thoroughfares, Chestnut and Richmond streets. The advantage of continuing this widened Aborn street outlet through to Weybosset street is, therefore, worthy of study. At the present time there is no through street existing from Mathewson to Jackson streets. Simonds, a narrow street, is practically opposite the Aborn street throat and the extension of Simonds street interferes with no very important

buildings on Weybosset street. Furthermore, the grade from Westminster to Weybosset streets at this point would not be serious, as would be the case further south, such as Empire street. As a choice, therefore, between the widening of Mathewson and Snow streets, or an Aborn street extension, the question must be carefully weighed as to cost and advantages before a reasonable decision can be reached. The object is the same: viz., to reach Weybosset street and the harbor district from the west side as directly as possible. For track looping any of the three can be used to good advantage. But, unless a more suitable street is provided, transverse traffic through the shopping center must be practically abandoned and the looping completed through Cathedral Square. In any case the widening of the south side of Aborn street from Atwells avenue to Washington street is considered immediately advisable.

An ultimate object of this transverse thoroughfare is the provision for a possible through route from the West Side to the East Side.

Fenner Street. Broad and Elmwood traffic that is desired to return via Westminster street must now loop through Mathewson street or some street further south. Fenner street opens most conveniently upon the important intersection of Weybosset and Westminster streets at Cathedral Square and outbound traffic would find an easy curve and grade through Fenner street to Broad street. A slight impediment exists in the bend of Fenner street, but this projecting corner might be advantageously displaced to the opposite side of the street. The extension of Fenner street in a straight line to Hayward Park, Plain and Point streets should also

be contemplated, giving a fairly level thoroughfare from Broadway and Jackson streets clear through to the East side, via Point street bridge. On this account Fenner street could now be widened to advantage for double track which could be used at the present time for transverse routing for expresses, extras and in emergencies, and in the future will become more and more needed.

Fountain Street. It has been urged that Fountain street be reserved entirely for vehicle traffic, owing to the preference of upper Fountain street over Broadway, as a means of climbing the hill. Observations have not borne out this fact and the wide detour necessary makes it undesirable to exempt Fountain street for vehicle traffic. Loading directly from Union Station and Gaspee street, Sabin street forms a direct vehicle entrance to Broadway and Atwells avenue.

Fulton Street. Although not concerned directly in the present transit problem, the importance of Fulton street as a distributor from Exchange Place is worthy of emphasis. Fulton street exists as a tangent from all of the important Exchange Place loops, providing a comfortable walking street for quickly reaching both Westminster and Washington streets through Eddy and Union streets. The width of the roadway opposite City Hall is 34 feet. This narrows down to 13 feet from Eddy street to Union street. The east property line is uniform with Exchange Place, while the west is contracted 21 feet. The character of the buildings on the west side is such as to confine the widening to a question of land value. When the Exchange Place loops are installed a great majority of suburban passengers will be discharged in front of the City Hall. It is, therefore, clear that such a restriction

should not be permitted in this most convenient quick outlet from the Exchange Place terminal.

Steeple Street. As public opinion seems unanimous on the widening project, it need not be further urged as necessary for accommodating by double tracks all North end traffic traversing Exchange Place.

Winter-Lockwood-Point. With the establishment of a cross-town line from Hoyle Square to East side via Point street bridge, a short offset at Broad street could be advantageously removed by aligning Winter and Lockwood streets the necessary few feet, giving an unobstructed route to the double track on Point street, returning to Westminster street via Summer street, when the capacity of the Winter-Lockwood single track is reached.

Elmwood Avenue-Park Loop. The facilities for handling the traffic to and from Roger Williams Park and the Baseball Grounds are inadequate, at the present time, owing to the contraction of Elmwood avenue, and to the lack of suitable terminal loops at the Park entrance. It is understood that the widening of Elmwood avenue is under consideration and this project is believed to be founded upon necessity.

The Elmwood avenue roadway is 36 feet in width at this point, the street car tracks converging from the curb to the center of the street. From a study of all the conditions involved, it is believed that the present side location of the tracks should be extended south at least to Whitney street. This conclusion is reached from the fact that if center tracks were adopted, six-line traffic is practically a necessity at the Park entrance, requiring a 50-foot roadway for vehicles 7 feet in width, or a 46-foot roadway for vehicles 6 feet in width.

allowing about one foot clearance between them. The latter would be suitable for automobiles and would allow even the larger vehicles to pass hub to hub. But as a 46-foot roadway seems to be out of the question, the present layout seems to be the best alternative, providing a 36-foot roadway in the center, easily accommodating four lines of large vehicles with proper clearance. This curb location of tracks possesses an important advantage providing convenient loading and unloading platform on the east and west sidewalks respectively, of ample length for the handling of any crowds. This will obviate the present danger of access to cars from the middle of the street, together with the resulting vehicle congestion.

For effective handling of these crowds, crossovers are quite inadequate. A loop should be established for both extras and regulars, discharging passengers before entering the loop and loading upon the tangent track. Such a loop would be desirable within the Park grounds near the main entrance, but is out of the question owing to the topography and location of buildings and driveways. Fortunately an alternative exists: Cars traversing a single track loop via Carlisle, Alger, and Whitney streets in the order named, would then reach the northbound main line in position to load along the tangent track opposite the Park entrance. This loop, however, should not be used as a storage track. With a little excavation, a two or three track siding accommodating six cars each could be built on Park land alongside the Park Brewery, connecting with the main line track on Elmwood avenue. On this siding, cars would be practically out of sight and the additional capacity for 1,500 to 2,000 passengers would be right on hand when needed.

While this loop would be of some assistance in handling the baseball loading farther north, a much better loop would extend from the Elmwood car house via Melrose and Longfellow to the main line northbound track. This has the distinct advantage that extra cars could be delivered at the entrance at the exact moment required, whereas the extras stored at the Park would have to be started northward sometime at a more or less uncertain period before the close of the game and would not entirely avoid the congestion which exists at present on the northbound track. It is therefore recommended that the loop at Melrose Park be installed immediately and the loop and storage track at Roger Williams Park entrance at the same time as the street widening project is carried out.

Maryland Avenue. A sharp contraction in Allens avenue exists along the section known as Maryland avenue. In the future this street, being the one straight thoroughfare to the south shore, will become more valuable for fast suburban travel and will require double-tracking. Arrangements should be made, therefore, to dispose of this contraction at least by reservation.

Smith Street. This street carries the converging traffic of Chalkstone avenue and Smith street to the Francis street hill. It is the only outlet of the Capitol and Smith Hill district, but is badly cramped by a single track, also the only thoroughfare radiating from the Capitol grounds of unsuitable width. The outlying territory of the third and tenth wards remains practically undeveloped because of the inadequate car service. The street should be widened to 60 feet, with a 36 foot roadway at least as far as Chalkstone avenue, in order to permit four-way traffic and double-tracking in the center.

Objection has been made to the destruction of trees, but observation of the irregular building and tree lines seems to indicate that in the past the possibility of a wider street than now exists was destroyed by the encroachment of abutting property owners. Widening of the north side where evidences of this encroachment exists, would occasion the least destruction of shade trees.

Encroachments from a set-back property line to the sidewalk line are usually evidences of the development of a residential street into a business street, so that stores will abut directly upon the walk. For such a street, property owners usually want streets widened to bring the walks up to their set-back building line for a business street. But if one breaks through the set-back line it is but a question of time when others will follow. The best plan is to prevent encroachments and widen the roadway and sidewalk to meet the set-back building line before business development of the street warrants.

Plainfield Street. On this street traffic converges from Thornton-Hughesdale and Pocasset avenue lines. A short contraction exists from Latham street to Pocasset avenue, which should be removed by widening to the standard 60 foot width of Plainfield street as it leaves Olneyville Square. This would permit double-tracking as far as the junction of Pocasset avenue, which is now required.

Street Widths.

The determination of the most economical width for thoroughfares designed for either vehicles or street car traffic

involves not only the actual width of vehicles plus a reasonable side clearance, but also the relative amount and character of vehicle traffic. Thus, it occurs that a narrow street with car lines is much less congested where only light or rapidly moving vehicles pass, than a street of the same width in the wholesale district where heavy slow moving vehicles predominate.

Furthermore, a street that will accommodate conveniently four lines of traffic on the tangent will be cramped at intersections, due to the overhang of front and rear platforms of cars, and this, again, varies in importance according to the locality. For a street outside of the business district, e. g., Broadway, one foot clearance between vehicles would be considered of ample width, even though the clearance would be reduced at any branch-offs by this overhang; that is to say, the comparative infrequency of interference at branch-off lines on such a street as Broadway would make it unnecessary to lay out the street width for full clearance at curves. On the other hand, Westminster street being practically full of vehicles, should theoretically be wide enough to clear them, even with the cars passing around curves. But, unfortunately, this is the case in but few of the down-town streets.

It also occurs that there is a certain range of width of roadway which will accommodate the maximum traffic, and by reducing the sidewalk width a little an additional line of traffic could be accommodated. Here, the City must sacrifice its standards to expediency.

Numerous measurements shown in Fig. 14 indicate that the majority of vehicles average 7 feet in width or under. Some vehicles, however, exceed 8 feet, such as certain types

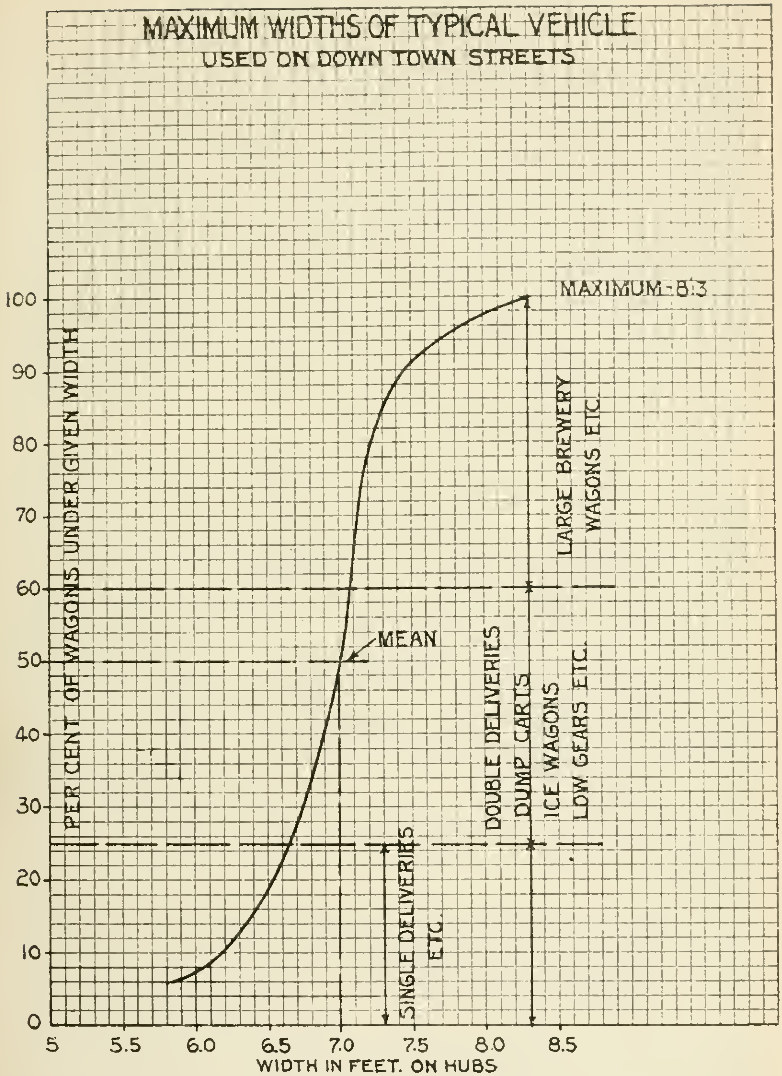


FIGURE 14—VEHICLE WIDTHS.

Comprising results of a large number of observations of vehicles found on the down-town streets. About half of the number were 7 ft. on width over hubs. The largest vehicle was 8′-4″ wide. The mean width, 7 ft., has been taken into consideration in all studies in this report.

of low gears, brewery wagons, etc. Taking 7 feet as a standard vehicle, the width of roadway necessary for three-line traffic, one a car line, is 23¼ feet minimum, or 25¼ feet with 12 inch clearance at hubs. But 35 feet and 37 feet, respectively, are required for clearance with cars rounding curves. Similarly with double track, a four-line street requires 32½ feet minimum and 34½ feet clear, and six-line traffic requires 46½ feet minimum and 50½ feet in the clear. A number of these street studies are shown in Plate XIV, some actual, and others proposed.

Thus, a standard 30-foot street is impossible to use for traction purposes. A 40-foot street with 24-foot roadway will barely accommodate one car line and two lines of vehicles without narrowing sidewalks. A 50-foot street and 30-foot roadway will accommodate one car line very comfortably, but not two, and a 60-foot street is just suitable for double tracks and two lines of vehicles. Six-line traffic, the most efficient method for handling large volumes, barely comes within an 80-foot street or 48-foot roadway. Obviously, streets as narrow as 40 feet and much used, should also have only one-way vehicle traffic, conforming to the direction of car movement.

On account of the absence of sufficiently wide streets for double-tracking, the City should not object to locating single tracks on parallel streets so as to avoid the delay at turnouts.

Offset Track. In case street widening is impracticable and parallel streets are unavailable, offset location of double tracks offers an alternative solution, as shown in the case of Broad Street, Plate XIV, thus allowing a clear roadway at the side for a single line of vehicles. Thus, a 50-foot street with

30-foot roadway will easily accommodate three-line traffic. This may have to be resorted to on outer Smith street and Chalkstone avenue. For a residence street no serious objection can arise. But for a business street the objection of discrimination in the matter of vehicles standing at the curb is made. One of these alternatives should be accepted. If a business street, the removal of trees should not be a vital objection, and if a residence street, offset track should be acceptable.

East Side Approach.

This has been discussed in general terms under transportation about Providence. The pressing need of such an improvement cannot be too strongly emphasized whatever its particular design may ultimately be; also the need of a continuously progressive plan of extension along broad lines, such as urged in the report of the East Side Approach Commission.

There are now only three alternatives: First, modification of College Hill approach; second, skirting the hill to the south via South Main street; third, to the north via North Main street. Either of the two circuitous routes obviously represents a makeshift, consuming more time than the present College Hill approach.

The present College Hill approach should be permanently discarded on account of the unavoidable physical obstruction of a 14% grade. It might be possible by slight easements in the grades of the various streets, to operate double truck

cars up the hill without the use of the present counter-balance; but during bad weather and with slippery rails, successful and safe operation would be practically impossible. Track brakes, it is true, might be installed, which would prevent accidental descent, but sufficient tractive effort in ascending cannot be always provided without the present counter-balance system, and the delay due to the latter is serious enough to at once insure its discontinuance in favor of an open grade street or a tunnel approach.

The alternative plans that have been presented in addition to the Freeman plan are many, but generally conform to the following classifications:

First, a traction tunnel directly through the hill from Market Square or Post Office Square to emerge at street level in the Thayer street valley, either at Angell street, Waterman street, Elm street or Fones alley.

Second, a traction tunnel from the same point clear through the hill to Butler avenue or Red Bridge.

Third, an extension of the second plan by means of an open-cut thoroughfare for cars only, from the mouth of the Thayer street tunnel along Fones alley and Medway street to the Seekonk River, tracks being depressed, in a manner similar to the Brighton Beach line in Brooklyn.

Fourth, an easy grade street from Market Square or Post Office Square to the hilltop for vehicles and pedestrians only, the adoption of which would in no way benefit the traction situation unless made available for cars.

The first plan is simply a revival of the plans proposed by the railway company and others many times previously.

The second tunnel scheme parallels the present railroad tunnel and is evidently advocated to prevent what certain residents of Prospect Hill term, "Undesirable encroachment."

The third plan eliminates any possibility of serving the East Side hill district with the improved car service desired, unless regraded entrances are introduced to connect Angell and Waterman streets with the depressed levels. This plan seems to be devised largely for heavy suburban traffic, whereas a more direct route via Washington Bridge exists for this traffic than would be presented here.

Any reasonable form of the fourth proposal is desirable from a standpoint of civic improvement. It is clear that the more direct it is the more effective will be the thoroughfare as a utility, which is primarily its function.

Up to this time none of the tunnel plans have seriously contemplated vehicle traffic. An enlargement of the tunnel for this purpose would probably increase the cost far beyond the present Commission's plans. In any event, it may be emphasized that a tunnel two-thirds of a mile in length is undesirable as a route for pedestrians and vehicles, although entirely suited for steam or electric cars. Furthermore, such an approach would most promptly develop a nucleus of a business district around the outlet, which is so much feared by the residents of the East side. On the other hand, an open thoroughfare traversing all of the north and south streets operates quite the opposite as a distributing instead of a concentrating medium.

Any reasonable re-routing scheme for the East Side district does not necessarily contemplate the use of the East Side approach for anything else than the lines devoted strictly to

the development of the Seekonk district. Unless a through tunnel is built, Washington Bridge, by virtue of its location, will continue to be the logical approach to the City of Providence for Riverside, Crescent Park, Bristol, and Barrington lines, and Taunton and Fall River suburbans. It is thus clear that the East side approach will be reserved for Brown, Camp, Hope, Governor, Brook, Elmgrove, Swan Point, Phillipsdale, Rumford, Hunts Mills, and similar lines reaching East Providence via Red Bridge. As pointed out elsewhere, the upper Seekonk represents the most favorable short haul district for immediate development in the entire Providence territory, and there is, therefore, little logic in the arguments advanced that the new approach will be a thoroughfare for heavy traffic which properly should not be routed through the residential territory.

If some form of approach project, either open grade or tunnel is not consummated in the near future, there is little hope of improving the present service to the East side through the two circuitous approaches remaining. The actual rerouting of cars is a very simple matter with any reasonable form of direct approach. One of the immediate results would be the replacement of single truck by double truck cars for the important lines.

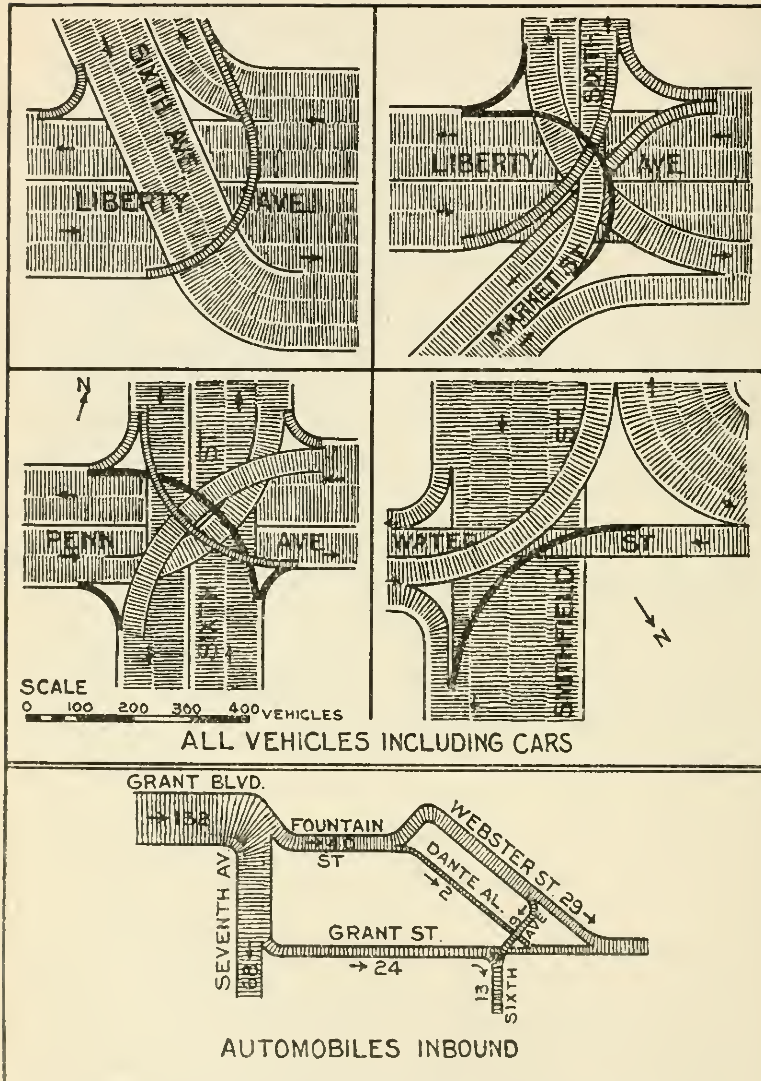
Shelters. Proposals have been made from time to time for the erection of adequate waiting stations for passengers at important waiting places, such as Exchange Place, and Olneyville Square, and it is understood that the Rhode Island Company has offered and agreed to co-operate in the erection of certain shelters. However, all the plans advanced have been rejected either on the score of inadequacy or through the objections of some citizens.

It is obviously a duty of the City authorities or a properly constituted City Planning Commission to evolve an adequate design for such shelters and secure their erection. With the extension of the transfer privilege such shelters will become more and more necessary in order to carry out most effectively any re-routing plan that involves heavy transfer traffic, such as express lines to Olneyville Square and East Providence. In fact, the success of the Olneyville plan would largely depend upon the possibility of passengers, when transferring at the Square, being able to find convenient shelter while waiting for their particular car to the outlying district.

Trunk Lines. The City lacks at the present time suitable trunk lines to handle express service to the suburbs. In the future this difficulty will be greatly accentuated. It is, therefore, very necessary as a function of the City Planning authorities to search out and provide such thoroughfares for express service as distinctly separated as possible from thoroughfares devoted to local traffic.

Studies in City Planning.

Vehicle traffic counts should be conducted at all the important street intersections in the congested district, showing by means of scale diagrams such as on Fig. 15, the relative traffic flow at these points in all directions; these traffic counts to be conducted over a considerable period of time at various seasons of the year, and under various conditions of maximum congestion. These diagrams will then show accurately the relative desirability of the various thoroughfares for vehicle traffic, and enable the more accurate assignment



TYPICAL DIAGRAMS SHOWING VEHICLE TRAFFIC MOVEMENT AT IMPORTANT STREET INTERSECTIONS IN PITTSBURGH.

FIGURE 15—TYPICAL DIAGRAMS OF VEHICLE TRAFFIC.

Representing the results of observations of vehicle movement at important street intersections in Pittsburgh from the Olmsted Report to the Pittsburgh Civic Commission. Relative widths indicate volume of traffic. Arrows indicate direction of flow.

of the car traffic to these same thoroughfares than would be possible from any study of car traffic alone.

Automobile traffic flow should be studied in the same general manner to indicate the preference of drivers for certain streets, this study having the same object as above. These studies will then furnish a basis for defining accurately the necessity for one-way streets for both vehicles and railways. Vehicle counts should include the study of the approximate character and tonnage of this traffic on the main down-town thoroughfares.

The economical width of thoroughfares is a subject requiring detailed and careful investigation with respect to character of occupancy, realty valuation, necessary width of sidewalks, property line encroachments, etc. Occasions may arise in which the City could provide alternative thoroughfares to better advantage than to extensively remodel an existing one. A profile model of the district should be prepared from contour section maps already available on large scale.

A grade map of the district should be prepared, showing, eliminated by means of shading, those waste areas in which the maximum grade exists, as, for example, 16 2-3% for vehicle traffic and 25% for residential purposes.

A map showing the character of occupancy of the district proper would be of great value, giving the location of important industries wih approximate number of employees; and showing by means of a code the general character of the property, such as manufacturing, wholesale, retail, and traffic centers such as theatres, halls, parks, pleasure resorts, and athletic fields, and finally, the rural and residential districts, with the necessary ethnological data.

Section II.

REROUTING AND SERVICE REDISTRIBUTION.

Synopsis: *Necessity for co-operative plan, down-town streets. Public record of operations. General principles. Loop routes. Street capacities. Alternative plan for relief of down-town streets. Service redistribution on outlying streets. Records. Trip counts. Haul. Stops. Headway. Through routes. Dead mileage. Specific recommendations. Trackage and service.*

The development of a satisfactory plan for re-routing is perhaps the most difficult problem arising in the present investigation. It is a fact borne out by experience that no fixed plan can be evolved by any one man or organization, that will prove satisfactory to all parties concerned. Re-routing affects so seriously the interests of so many separate localities that it becomes a matter for arbitration rather than of individual judgment. Providence is no exception and the most that this report can hope to accomplish is the submission of possible alternative plans combining the best features of those proposed and approaching nearest to the ideal. By process of elimination, the final plan must then be gradually developed after numerous conferences and hearings thereon. But the main point of value is that improvements are possible by any of several plans submitted.

Two distinct problems are involved in the execution of such a plan, first, relief of the main thoroughfares of the loading district, and second, improved distribution in service over the outlying lines. Supplementing the latter, a study of routes differing from those at present in use or representing an extension of them is desirable as a provision for future development. And, in this connection some system should be used for maintaining a public record of schedules, delays, and accidents so that the causes of obstruction could be more intelligently discussed and the service improved by their removal.

REROUTING IN THE TERMINAL LOADING DISTRICT.

The down-town loading district extends from Market Square on the east to Cathedral Square and even to Hoyle Square on the west, and from Union Station to the river in the other direction. Given a limited number of streets, the first problem resolves itself into re-grouping the various lines so as to utilize these various streets more uniformly and effectively according to their respective usage and widths of available roadway. Any such theoretical arrangement then must be modified to some extent in order to avoid departing too far from such important points as the Civic Center, the railroad station, and the shopping streets.

First, the car capacity of streets and crossings must be determined in terms of maximum car transits per hour per-

missible under the conditions. Here the relative width of roadways and volume of pedestrian and vehicle traffic must be duly considered. The minimum car interval may be determined as equal to the average loading time, taking advantage of multiple car loading at necessary points.

Next, the most desirable loops for both City and suburban routes are to be selected, reserving those streets best suited to the particular class of service desired or for the cars from particular districts that may be most logically routed over them.

Finally, the relative assignment of through routes and loop routes for City lines must be made. This involves segregating those long haul lines which would not be well suited for through route operation, and finally, the connecting up of short haul lines on opposite sides of the City having equal or multiple headway so as to secure the most direct routes through the business district. And care must be taken to properly serve certain communities of interest on opposite sides of the city with the through service demanded.

For the present it must be assumed that the existing route destinations are satisfactory and therefore the analysis will be confined to devising more suitable routings through the loading district. The larger problem of rearranging these existing routes as to their destination is one which can hardly be attempted in its entirety without the assistance of extended co-operation and conference between representatives of the Company and the districts affected. Certain evident modifications, however, may be suggested at this time with propriety.

General Principles of Terminal Routing.

Long haul routes are best suited to looping at central terminals.

Short haul routes having equal or multiple headway may be connected so as to secure the most direct route through the City.

Long haul suburban lines should use the shortest possible outlying loops, i. e., just outside the congested centre to avoid the delays in traversing the congested district.

Short haul loop lines should use the loops which pass through or around the retail district, distributing the loading as much as possible.

Permit only straight-away crossings instead of branch-offs at seriously congested street intersections such as Westminster and Mathewson streets.

Use no transverse street to close a loop that has not sufficient capacity for absorbing a five minute accumulation of cars without interfering with traffic on main intersecting streets, e. g., Mathewson, Westminster to Weybosset streets.

Branch-off in the direction of flow, i. e., to the right on outbound track, not to the left against the flow of inbound tracks.

Avoid crossed or figure eight loops; keep the throat open if possible.

Avoid counterflow operations at all junctions of single track with main lines, e. g., Constitution Hill and Richmond Street.

Double track on parallel or alternative streets on lines of heavy traffic, at least outside of the loading district.

Provide independent routes for single track lines except all cars moving in one direction.

Determine the ultimate capacity of present streets in order to plan for the creation of new ones as needed in the future.

Outlying communities of interest should receive consideration in locating through routes.

Business and private interests must not be allowed to unduly influence the assignment of routings to *specified* streets where manifestly improper for the most effective and direct operation.

A walk of one block from any point to a desired car line is to be considered within the bounds of good service for any business house if this distance is necessary for an adequate re-routing scheme.

An East Side approach, either open grade street or tunnel should be embodied in any new plan for present or future re-routing.

A one-way Exchange Place Loop completely encircling the Plaza should be used to relieve the Union Station loop and lines now diverted via Dorrance street; unloading taking place at the western extremity and loading, along the south Exchange Place tangent.

Loop Routes. In a city provided with the necessary thoroughfares it is desirable to separate the terminals of the long haul from those of the short haul traffic in order to decrease the long haul running time. This can be done by means of a long and short loop system. Long haul passengers will walk considerably further away from the centers to the nearest loading point if some running time to the suburbs is saved. On the other hand, short haul passengers are best accommodated by loops carried around or through the retail centers. Further,

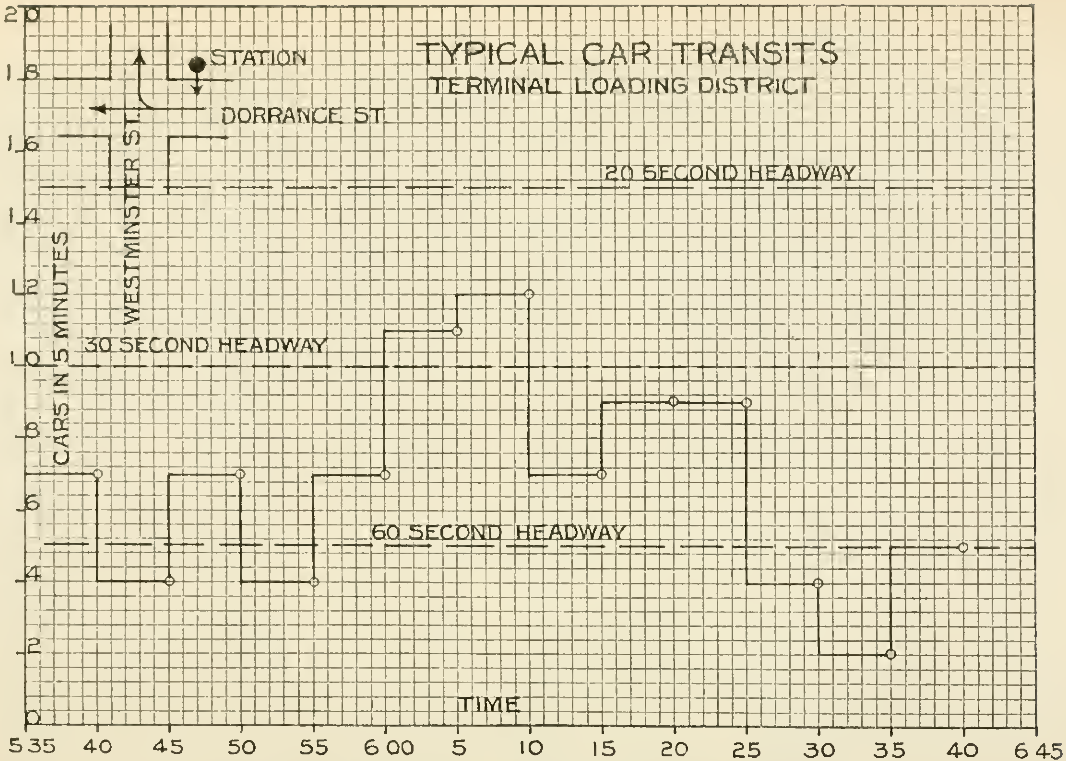


FIGURE 16—TYPICAL RECORD OF CAR TRANSITS.

A graphical record of cars passing through Dorrance street southbound during 5-minute intervals of the rush hour. The maximum number of cars pass shortly after 6 P. M. An average headway of about 30 seconds continues from 6:00 to 6:25 P. M.

the separation of the two loop systems will automatically tend to segregate the long haul and short haul traffic as is needed in order to reserve the necessary through seats for the suburban passengers.

But in Providence this system is difficult of execution as few streets are available. The only examples of outlying terminals at present in operation are the Riverpoint express loop via Winter, Washington and Mathewson and the suburbans dead ending at Market Square. In a similar manner the Washington Park express via Eddy street might short loop via Weybosset and Richmond streets instead of crossing the business district twice as at present. It is apparent that in order to carry out a system of this kind, fairly wide streets should be available. Mathewson street is much too narrow, and if a wider transverse street cannot be created then it will become necessary to concentrate most of the looping at Exchange Place. In fact, the Exchange Place loop may become so popular that outside short loops will not be in great demand.

Relative Street Capacities. To provide a clear track through the loading district cars must not be spaced closer than will enable them to reach the next stop while the car following is loading, i. e., the headway should not be less than the average time of loading. Observations at Dorrance street, Fig. 16, show that cars passed in one direction during the rush hour at an average headway of forty seconds and required 13½ seconds per stop (see table 15). However, the minimum headway was frequently less and the delay in loading greater so that congestion occurred. At various other loading points downtown the average time observed per stop was 8.7 seconds. If

we allow ten seconds per stop throughout the loading district, the distribution of cars should be as follows:

Average speed between stops	Number cars per 260′ block	Maximum cars per hour
4.5 miles per hr.	4	72
6	3	90
9	2	120

For a reasonable speed it is evident that an effort should be made to reduce the car flow per hour in the loading district well below 100 cars per hour under the best possible condition of street traffic. At present the rate is as high as 133 cars per hour on Weybosset, inbound 110 on Westminster street and 67 on Mathewson. Plate XV gives a general impression of the actual car flow on various streets.

Considering now the available roadway we find that the street capacities vary widely.

	Width in Feet		Lines of Vehicles		(7 ft. vehicles) Net Clearance
Street	Street	Roadway	Cars	Wheel	Each side
Dorrance	64	38	2	2	32″
Broad	66	36	2	2	19″
Broad and Chestnut	62	32	2	2	None
Washington	60	41	2	2	50″
Weybosset	50	24	1	2	4½″
Westminster	48	24	1	2	4½″
Mathewson	40	21-22	1	2	None
Broadway	80	50	2	4	20″
Friendship	40	22	1	2	None
Richmond	45	26	1	2	16″
Fountain	50	28-29-30	1	2	34″
Chestnut	40	23	1	2	None

In view of these results it occurs that the relative street capacities for surface cars as determined upon must be modified by the width and vehicle traffic. For example, Westminster

street cannot handle more than two-thirds the cars per hour as Washington or Dorrance streets inbound or outbound and Mathewson barely one-half the number. Fountain street, on the other hand, will handle conveniently as many or more cars than Dorrance street. To bring this out more graphically, Plate XVI has been prepared which shows the relative car congestion on various streets reduced to a basis of roadway width.

Analysis of Rerouting Plans for Loading District.

All four plans as shown in detail in the accompanying Plate 17, A, B, C, D, embody the following improvements: East Side approach from Exchange Place terminal loop, Friendship street extension to Dorrance, Claverick street connection to Bassett, Fenner street connection to Broad, Washington Row connection to East Side approach. Destination of present car lines unchanged.

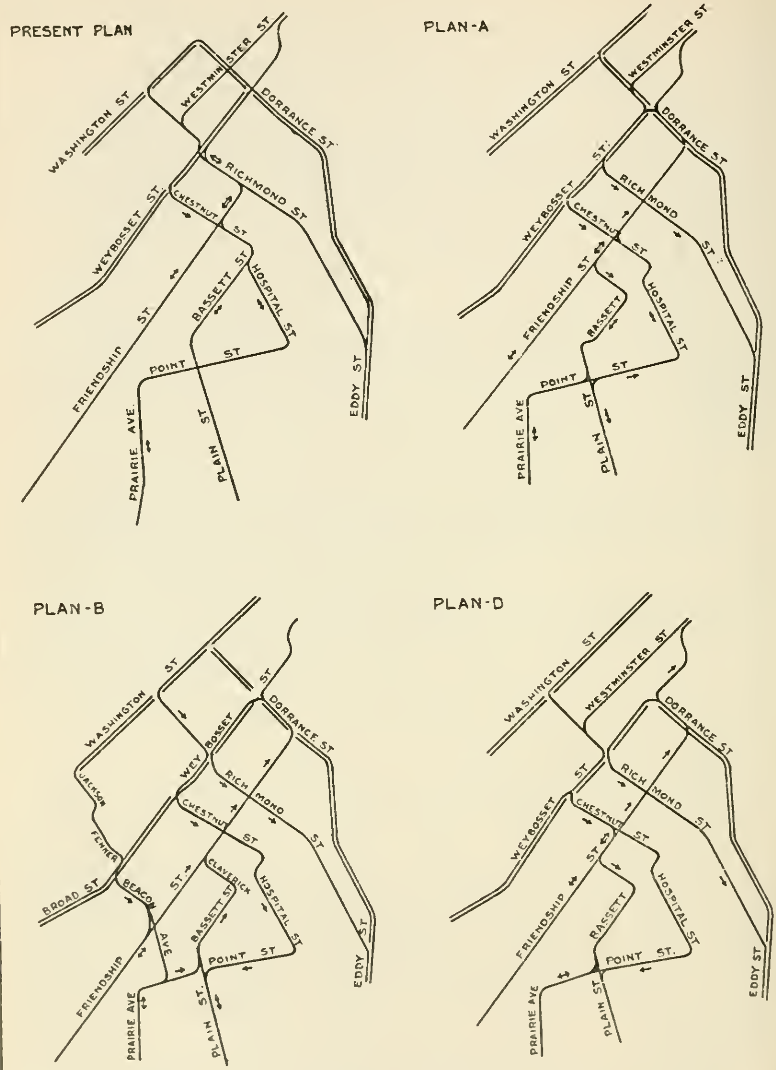
Plan A. Tentative plan submitted by Company to accomplish immediate relief.

Prairie avenue and Ocean street cars outbound via Dorrance, Weybosset, Chestnut, Friendship and Claverick streets. This gives a double track (excepting one block of four hundred feet on Friendship street) route from Market Square to the corner of Point and Plain streets and individual single track beyond.

Inbound cars via Friendship, Dorrance, Weybosset streets and Washington Row to East Side approach.

Eddy street cars inbound via Dorrance street, outbound via Weybosset and Richmond streets, looping around Narragansett Hotel.

Fenner street, north-bound only, used for routing River-



REROUTING PLANS FOR SOUTH PROVIDENCE CARS
FRIENDSHIP, PRAIRIE, OCEAN, AND EDDY STREET.

FIGURE 17—REROUTING PLANS FOR THE TERMINAL DISTRICT.

These diagrams show directions of routing under the present and proposed plans for relieving the street congestion in the down-town district.

Figure 17 A—Plan Proposed by Rhode Island Company.
Figure 17 B—Proposed Plan Based on Ideal Car Redistribution.
Figure 17 C—17 B Modified to Better Reach the Retail District.
Figure 17 D—Proposed Plan Combining 17 A and 17 C.

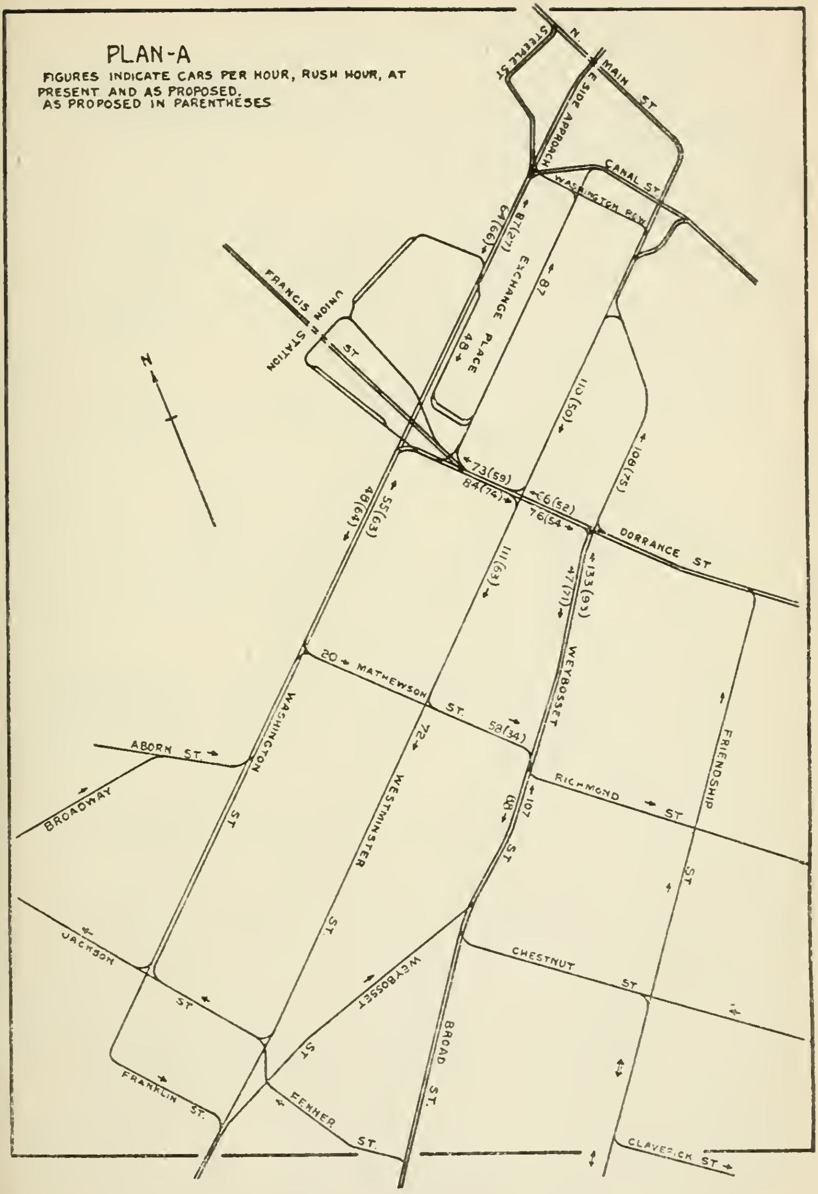


FIGURE 17-A
Plan proposed by Rhode Island Company.

point, East Greenwich and numerous Broad street, Edgewood and Pawtuxet extras to Washington street, looping around City Hall.

The Riverpoint cars now run through Winter street, the other lines directly down Weybosset street, but owing to the present slow operation down Westminster and Weybosset streets, the Fenner street track would reduce the running time to center of City materially.

The Fenner and Friendship extensions would remove 35 to 40 cars from Weybosset street which is the most congested point.

Cranston cars outbound via Westminster street, inbound via Weybosset street, all looping around Turks Head, except through routes, and the Oaklawn line inbound which would run via Washington street.

All Olneyville and Mt. Pleasant cars outbound via Washington street, Governor-Brook-Plainfield street line from East Side, crossing through Canal street to Exchange Place and Washington street.

All Elmwood cars outbound via Westminster, Mathewson and Weybosset streets, inbound via Weybosset street.

Lines at present dead-ending at Market Square loop around Exchange Place; also Riverside, Warren & Bristol lines.

Pawtucket lines loop around Exchange Place.

Broad street lines loop at Union Depot as at present.

This plan (A) allows passengers from sections of the City covered by several lines to board any of these lines (outbound) at the same point.

Plan B. Designed as an ideal distribution of cars according to street capacity. Embodies in addition to the above, Fountain street loop with double track on Aborn. Fenner

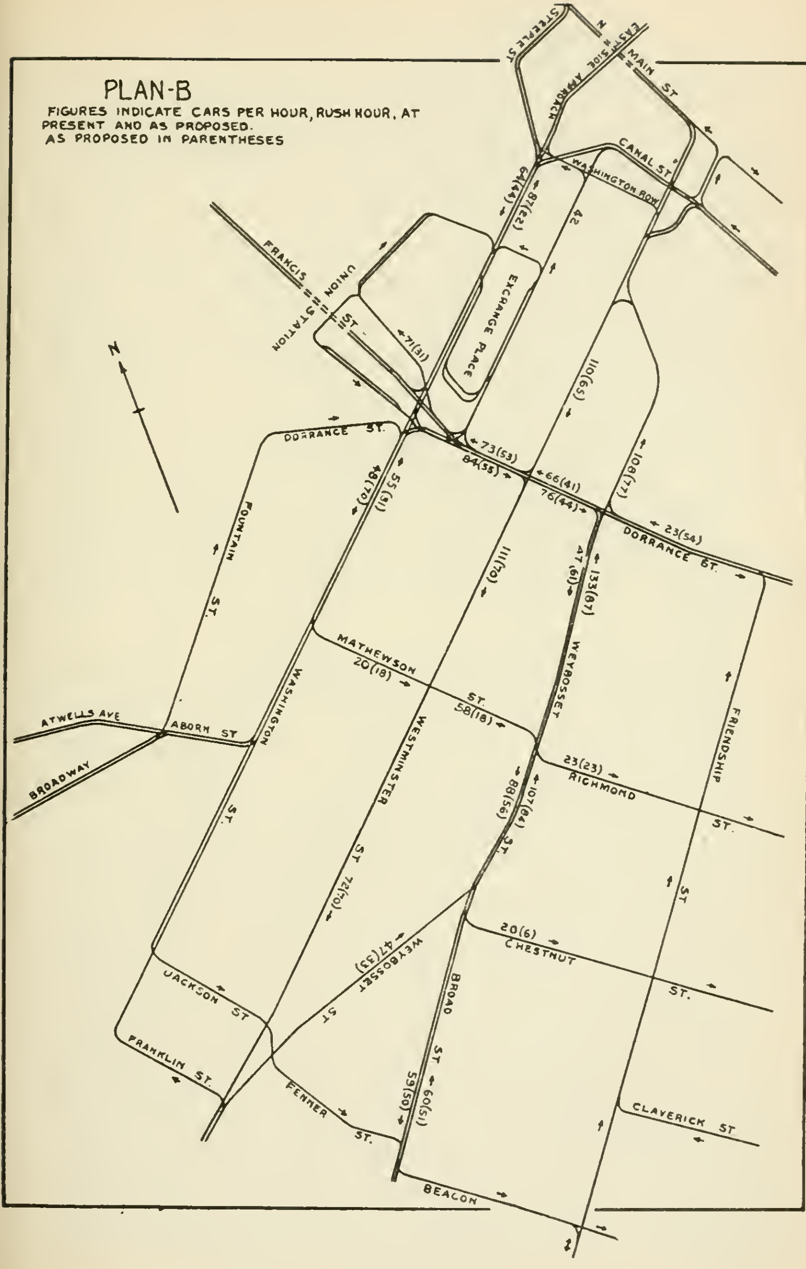


FIGURE 17-B

Proposed plan based on Ideal Car Redistribution.

and Beacon streets southbound. Direction of operation on Franklin and Jackson streets reversed. Olneyville and Mt. Pleasant cars, express and interurban via Fountain street loop, locals via Washington street. Elmwood cars mostly via Weybosset street. South Providence cars outbound via Washington, Fenner and Beacon streets inbound via Friendship, Dorrance and Weybosset streets. Cranston cars outbound via Westminster, inbound via Weybosset street. Broad street cars loop at Union Station. Pawtucket cars loop at Exchange Place. Attleboro and Woonsocket cars loop at Board of Trade. Riverside cars via Westminster, Dorrance and Exchange loop. Taunton and Fall River cars dead-end at Market Square. Centerdale via Smith dead-end at Francis street under Union Station.

This plan makes Friendship, Prairie Avenue and Ocean street, one-way lines north of Hayward Park, relieving all counter-operation on Friendship street. It carries the majority of Westminster street traffic through to Cathedral Square before diverting southward to Broad Street; relieves Mathewson street of cross-traffic except through-traffic from Washington to Weybosset streets; establishes outlying short loop terminals for express and interurbans; utilizes Union Station loop for Broad street traffic and Exchange Place loop for Pawtucket and for long haul cars from south and southwest.

Plan C. Modification of plan B, so as to bring more local cars and the outlying terminals of plan B through or nearer to the retail district. Attleboro and Woonsocket cars loop at Exchange Place. Broadway locals use outer loop via Jackson, Weybosset, Dorrance, Washington and Aborn streets. Taunton, Fall River and Riverside cars loop via Westminster, Dor-

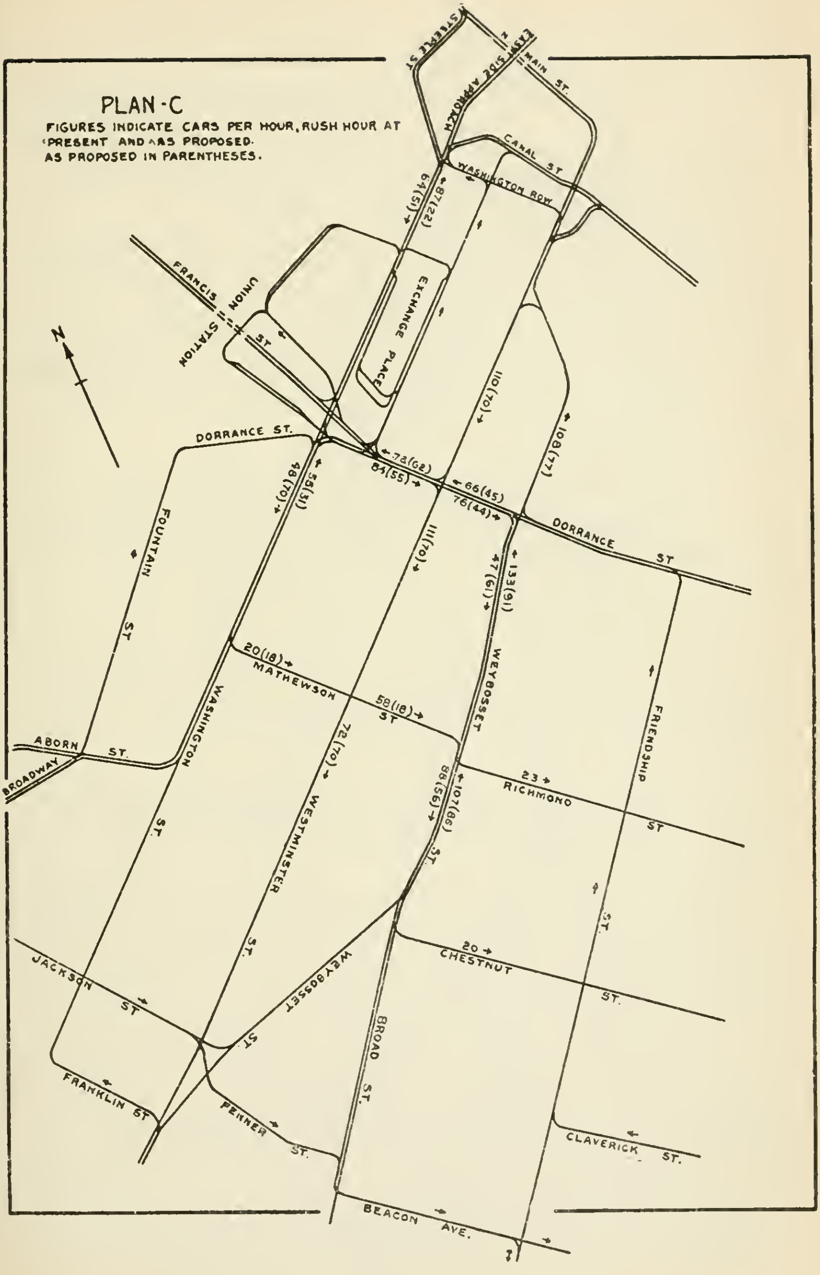


FIGURE 17-C

17-B Modified to better reach the Retail Districts.

rance, South Exchange Place and Canal street. Centerdale via Smith street cars loop around Exchange Place.

Plan D. Further modification of plan B routing South Providence cars southbound via Richmond and Chestnut streets instead of counter-operation on Friendship street as in short stretch of counter-operation on Friendship Street as in Plan A. Friendship street cars only outbound via Westminster and Mathewson streets; all others via Washington and Mathewson streets.

Fenner and Jackson streets used northbound only for expresses and extras as in plan A. Broadway locals loop through Washington, Mathewson, Weybosset and Dorrance streets instead of Jackson street.

Mathewson Street could be further relieved by routing Friendship street cars outbound via Dorrance and Weybosset, leaving thereon only 26 cars from Washington to Weybosset streets.

If Fenner street were double tracked, routing Auburn and Eden Park cars outbound thereon would remove 12 more cars from Mathewson street.

It will be observed from Table 16, that any one of the four plans submitted is superior to the present plan of operation in respect to the distribution of car flow. Plan A is a great improvement, but burdens Mathewson street and does not contemplate the use of Fenner street as an outlet from Westminster street. The ideal Plan B is perhaps too radical for the present, but plan C certainly should prove acceptable. Plan D is less desirable.

These various plans, therefore, are presented for public discussion. One of them should be adopted or else a combination

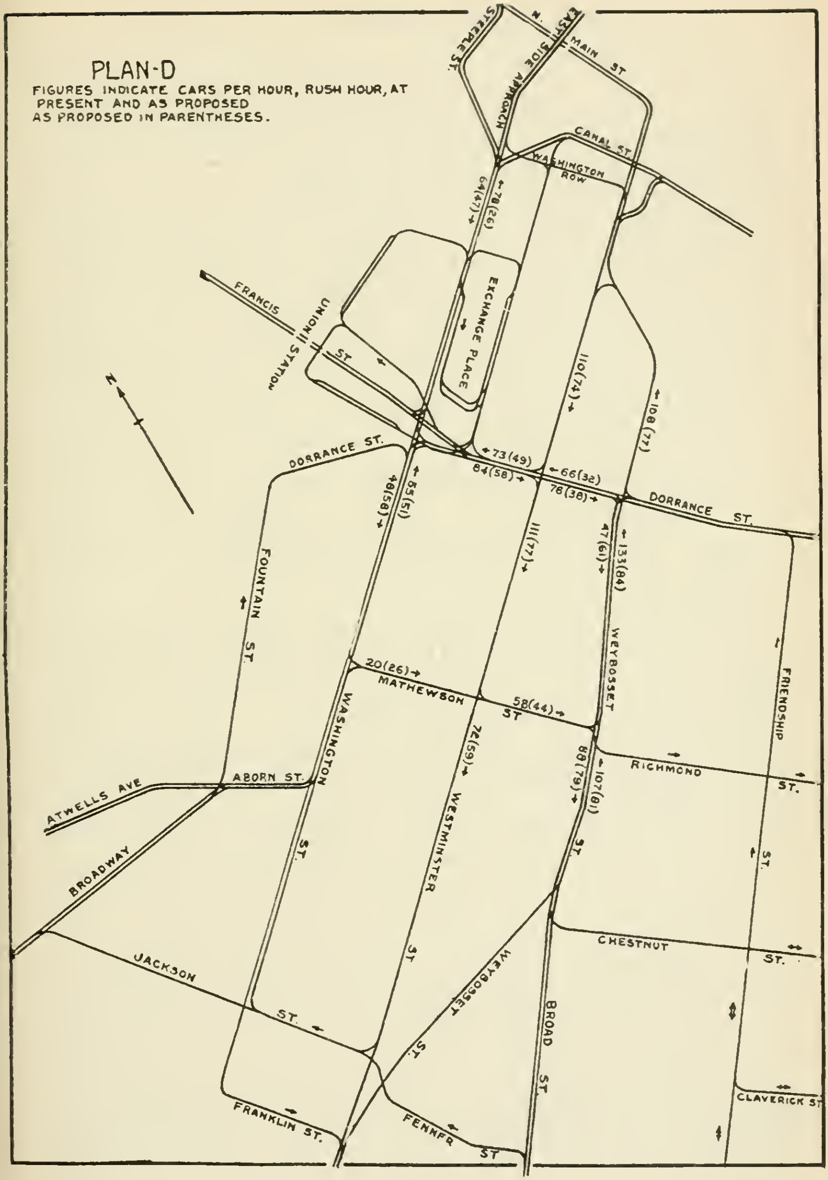


FIGURE 17-D

Proposed plan combining 17-A and 17-C.

plan, but not one so greatly modified as to practically revert to the present conditions. Here at least is a starting point demonstrating that great improvement is possible.

Emergency Routing. It is essential that the City permit tracks to be laid in certain down-town streets for the sole purpose of emergency routing, whatever the necessity for or objection to such occupancy for regular operation. The complete disorganization of the present traction service by a fire, parade or other emergency should be a sufficient reason for the permission of such supplementary trackage. For the most part, a few short connections between existing lines will suffice, and with grooved rail and tracks properly laid no serious objection should arise on the score of unnecessary pavement disturbance.

Such an emergency connection, for example, is needed on Eddy street from Dyer to Friendship streets, allowing inbound Eddy street cars to avoid any obstructions along east Dorrance or Dyer streets. With Richmond street, sufficient double track would be available to clear the most congested section of the regular Eddy street route. Fountain street and Fenner street will also be of great value in emergency routing.

Exchange Place. In planning this important loop the City should entertain no apprehensions in granting an adequate system of track and special work. Nothing will be gained by limiting to a single track loop. First, loop cars inbound from North Main street should clear the Washington street tracks as soon after passing the Post Office as possible which will necessitate a third parallel track on north Exchange Place. Second, two or three unloading curves should be installed at the west end of the loop to discharge passengers as near to the

Dorrance street entrance as possible. Third, two tracks should be laid on south Exchange Place, the outside for local cars running through without layover and the inside for accommodating several interurban cars which require a short layover. In the absence of a suitable shelter or waiting room, passengers arriving early will find these interurbans standing in a convenient position while not obstructing street traffic as would be the case were they standing upon the curves at the west end. These extra curves will be of maximum advantage during rush hours in permitting late cars to forge ahead and regain schedules. Fourth, the two sides of the loop should be connected opposite Exchange street and entrance curves installed at Dorrance and Francis streets to permit the loop to be used by cars from the West Side or other districts. Fifth, the southerly track should extend straight through to Washington Row, there connecting with both Canal street and Steeple street tracks. A supplementary connection in Washington Row is needed to enable through routes passing Turks Head to reach the East Side approach conveniently. This will avoid the necessity of using either Exchange street from which tracks have been removed or Dorrance street.

REDISTRIBUTION OF SERVICE IN THE OUTLYING DISTRICT.

Leaving the terminal district, the problem of service redistribution outside, resolves itself into certain basic questions, considered for each of the 55 individual routes. Assuming an increase of 1,622,000 car miles per year to be distributed equi-

tably over the system, as developed in a former chapter, answers to these questions should be developed ultimately in one or all of the following forms:

Is day or rush hour service deficient, or both?

Are more cars needed or will faster schedules suffice?

Should present runs be extended?

Is present day headway sufficient or should it be reduced?

Will short haul extras relieve long haul cars?

Will a split headway or "double-header" trippers best serve rush hour load?

Are limited-stop expresses necessary to reserve sufficient long haul seats?

Should express stops be limited during rush hours only?

What track modifications are necessary to avoid delays?

Do earnings and passengers per seat mile indicate need of service improvement?

Are seasonal variations properly provided for?

It will be obvious that extended observation over a considerable period of time is necessary to reach a conclusive answer on many of these questions. This report can only outline the methods to be used. Upon the operating organization must fall the task of reorganizing services where such observations indicate the necessity.

Yearly Route Records. An exact idea of the comparative importance of the various routes as operated in 1910 may best be had from a study of Plate XVII, which shows for each route by the height of the block the following:

1. Passenger earnings.
2. Total passengers carried including transfers.
3. Relative importance of transfer traffic.

4. Ratio-earnings per standard car mile.
5. Ratio-total passengers per car mile.

Owing to the use of cars of different seating capacity the two car-mile ratios have been reduced to a seat-mile basis by converting the actual car-mile records into those for a standard 42-seat car. On this basis, all routes are comparable and those of poor earning capacity are easily distinguishable from the more profitable ones by the relative height of the blocks. A dotted line has been drawn through the diagram representing earnings of 30 cents per standard car-mile which has already been used as a basis of computing service. See also Table 17.

It will be noted that the earnings on the important lines per standard car-mile vary approximately from as low as 16 cents on the Smithfield avenue line, to 20 cents on Charles street, 25 cents Branch avenue, Manton avenue, Centerdale, Hughesdale and Oaklawn, 30 cents on Riverside and Riverpoint, 35 cents on Pawtuxet and Pawtucket lines, Auburn-Camp street, Olneyville-Brook-Governor, and Friendship-Admiral, 40 cents on Dyer avenue-Swan Point and Arlington, 45 cents on Atwells-Taunton, and Elmwood-Chalkstone to around 50 cents on Ocean-Hope,-Prairie-Butler-Camp and Dexter-Douglas. The striking fact presented here is that the through routes show the highest earnings per car-mile and the long haul loop lines, the lowest. This is reasonable, for the trip counts show that the great proportion of the through riding is short haul, not from end to end of line.

Monthly Route Records. In order to determine the effect of seasonal variations in traffic as compared with the actual counts made, the history of the route for an entire year must be studied. Typical records of the kind are shown in Plate XVIII, selected to illustrate the points below.

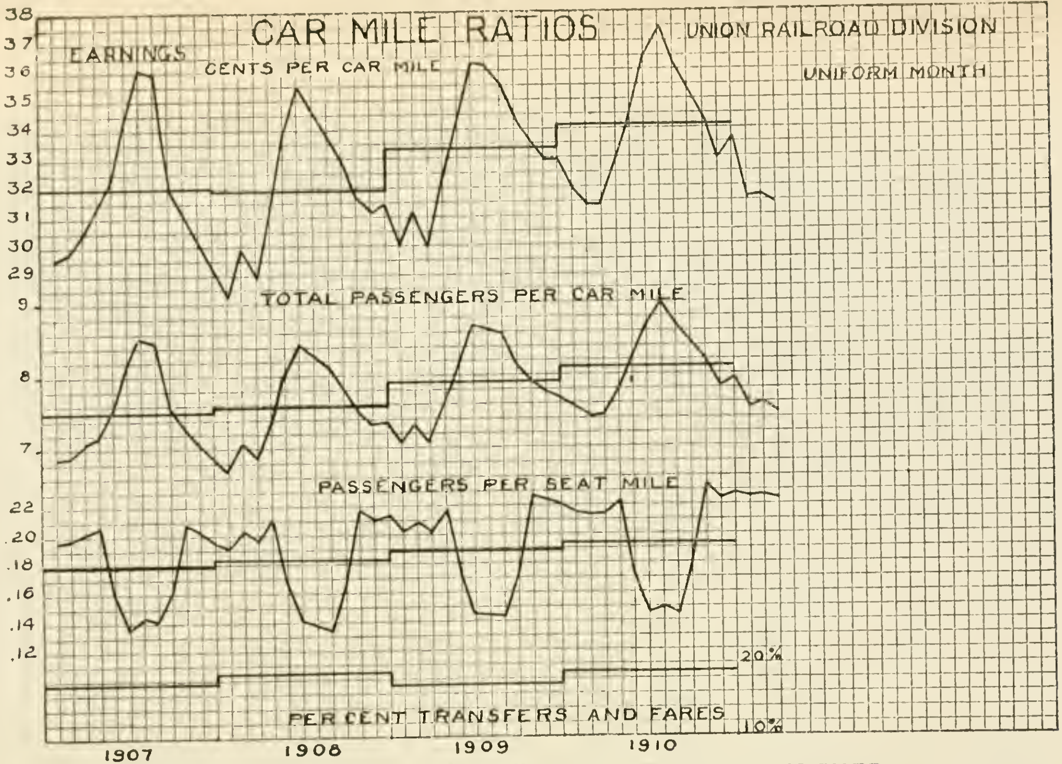


FIGURE 18—RECORDS OF COMPARATIVE SERVICE FURNISHED.

As an index of the standard of service, earnings and passengers per car mile, also passengers per seat mile are recorded here graphically. These ratios are of value in tracing the history of service from month to month and year to year. For the same car equipment, increasing earnings or passengers per car or seat mile, mean relatively poorer service or vice versa. Within the past four years the standard of service in Providence has gradually decreased. Note the influence of the summer cars in reducing the passengers per seat mile, i. e., summer service is much better than winter service. Only about

1. Slight seasonal variations: (a) through route—Ocean-Hope; (b) loop route—Union Avenue; (c) interurban—Woonsocket.

Heavy summer traffic: (a) Suburban—Riverside and Crescent Park; (b) Long haul city—Edgewood and Pawtuxet; (c) long haul suburban—Buttonwoods and East Greenwich.

3. Reduced summer traffic: (a) Long haul—Thornton; (b) short haul—Thurbers avenue.

4. Continued growth—Washington Park via Broad street.

5. Rearrangement of through routes with increase in traffic Broadway-Elmgrove to Elmwood-Elmgrove.

6. Increased traffic; decreased service—Park Avenue.

7. Summer traffic only—Rocky Point.

8. Sharp summer peak—Pawtucket-East Providence.

These records, it must be borne in mind, are only to be regarded as illustrative of seasonal variations. For a detailed study each of the 52 routes must be examined. In general, a marked divergence of the two curves indicates relatively poorer service and vice versa, i. e., car mileage should increase and decrease approximately in proportion to passenger traffic as is usually the case. This, however, is not an exact measure of relative service between summer and winter for the reason that summer equipment has the greater seating capacity and somewhat fewer cars are required for the same passenger traffic.

This is illustrated in Fig. 18, by the fact that while the maximum passengers *per car-mile* occurs in the summer the maximum *per seat-mile* occurs in the winter considering the system as a whole; i. e., summer service is relatively better than winter.

Trip Records. Finally, an accurate measure of service on various routes necessitates a record of typical car loading and

destination of passengers. During March and April, 76 such counts were made from which loading characteristics of individual routes were obtained. Tables 18-1 to 7 comprise the results and Plates XIX, A, B, C, indicates them in graphical form for typical routes, such as limited express, long and short haul loop lines, through routes, trippers, etc. These records show where passengers get on and off, the average passenger haul in miles, the relation of seating capacity, maximum load and fares registered, the adherence to schedule time, the cause and location of schedule delays, the imposition of short haul upon long haul riding, and the effect of stops upon running speed in various sections of the City; and further, whether the particular trip observed is reasonably typical as compared with all preceding trips as well as those following. Therefore, a complete history of operations for one day is here available. To facilitate this work the Company split each through route, on the day of observation, i. e., kept separate records each way from the center of the City on all through routes, otherwise it would have been impossible to determine whether the trip count was representative of rush hour conditions.

Population Density. The density of tributary population per mile of route i. e., per mile of street traversed by only a single route, estimated for the residence section of the City only, shows that many of the lines traverse very thickly settled territory, especially those listed below in the order of density:

	Persons
Atwells-Academy-Broadway to Terminus,	13,700
Prairie Avenue, Point to Thurbers,	7,630
Governor Street-East Street to Terminus,	6,550
Douglas Avenue-R. R. to Terminus,	5,850

Ocean Street, Point to Thurbers,	5,400
Cranston Street, Parade to City line,	5,260
North Main Street, Olney to City line,	4,720
Dyer Avenue, Plainfield to Roger Williams Avenue,	4,580
Broad Street, Friendship to City line,	4,500
Manton Avenue, Olneyville to City line	4,400
Elmwood Avenue, Trinity Square to City line,	4,230
Charles Street, Branch Avenue to City line,	4,200
Union Avenue, Cranston Street to City line,	4,180
Low Densities.	
Hartford Avenue, Olneyville to City line,	1,910
Smith Street, Chalkstone to City line,	1,375
Entire East side, 1st and 2nd wards, including North Main Street,	3,100
Entire City of Providence,	3,075

This list is by no means complete as there are other dense lines, such as Broadway and Chalkstone avenue, but all these cases were omitted as the tributary population could not be estimated with the necessary degree of accuracy owing to the complication of superimposed routes. These figures, however, do indicate where the highest earnings may be expected.

Traffic Density. Carrying this thought one step further, the actual earnings per mile of route per year have been analyzed in connection with the earnings per seat-mile (the best index of service) in order to indicate whether the service provided is commensurate with the riding of patrons along these routes. For this purpose, the seat mileage of through routes has been computed separately each way from the center of the City. Likewise, the annual earnings. Below are listed certain routes on which the earnings per seat-mile are higher than normal

and the earnings per mile of route also sufficiently high to warrant an increase in service if otherwise shown to be necessary. The average earnings per mile of route for the Union Division is $11,330, and normal earnings of 30c. per car-mile correspond to 0.7c. per seat-mile.

Routes Earning over 50% above Normal—1.05c. *per Seat-Mile.* *Ocean*—1.53c. per seat-mile—$25,000 per mile route. Broadway (Phillipsdale-Rumford)—1.19c., $30,000. Dexter—1.13c., $14,060. Camp (Auburn)—1.1c., $21,100; also Douglas, Elmgrove and Butler (Prairie).

Routes Earning 25% to 50% above Normal. Prairie—1,05c., $26,100. Dyer—1.04c., $14,070. Arlington—0.98c., $30,800. Chalkstone—0.98c., $27,760. Academy—0.95c., $28,920. Taunton—0.88c., $27,200. Friendship—0.94c., $21,870; also, Camp (Prairie), Governor, Hope, Reservoir, Brook, Union, Cranston Print Works.

Routes Earning from 10% to 25% above Normal. Plainfield—0.85c, $25,860. Elmwood (Chalkstone)—0.83c., $12,450. Broad (Edgewood, Pawtuxet)—0.82c., $47,200; also, Rumford and Swan Point.

Routes of about Normal Earnings 0.7c. *per Seat Mile.* Pawtucket (Main, Garden)—.76c., $29,400; also, Auburn, Centerdale (Manton), North Attleboro and Admiral. Other routes are either low in earnings per seat-mile or very low in density. It should be emphasized that the fact of high earnings per mile or seat-mile does not necessarily indicate poor service except in comparisons of the same route or the entire system from month to month and year to year; but it does indicate what parts of the system have sufficient earning power to make improvements possible, either on those lines or other non-

paying lines needing assistance. There must necessarily always be some non-paying lines in a large system.

Referring again to Fig. 18, it will be noted: 1st, that the average number of passengers per seat-mile has increased materially since 1907, which indicates relatively greater loading; 2nd, that the curve of passengers *per seat-mile* varies oppositely to that *per car-mile* indicating much better service in the summer than in the winter, due to open cars; 3rd, that the winter loading remains fairly constant (flat topped curve); and 4th, that the winter loading as compared with the summer has been increasing since 1907. This is indicated by the fact that the winter crests are ascending rapidly while the summer minnima remain about the same; also, that the winter crest is getting higher and higher above the average for the year. Finally, the curve shows that the service during January, February and March bears about the same relation to the year's cycle as in previous seasons, which means that this investigation was conducted under fairly normal conditions and that the service was not temporarily improved.

General Deductions.

Length of Passenger Haul. On many of the longer outlying lines the average ride is from 4 to 7 miles and it is generally the fact that the loading upon these lines is about as heavy as on the City lines; in some cases, heavier. This results in a standing load often exceeding five miles. It is believed that less standing should be permitted on these long haul lines than

on short haul city lines for the reason that persons do not object to standing for a short distance, while a standing trip of thirty or forty minutes is extremely fatiguing. It is true that the Company allows a maximum of only 50 to 60 persons on the cross-seat suburban cars. Nevertheless, this standard is not sufficient and every effort should be made to maintain a practically seated load on hauls in excess of four miles. This can only be done by short haul trippers and extras as later indicated or with limited expresses.

The average passenger haul over the lines of the Union Division was determined by passenger counts as 2.07 miles. This is low, as much as 30% below some cities. Short haul means high earnings and in return therefor the Company should not hesitate to relieve the long haul service which can hardly be expected to result in as high earnings per car or seat-mile as short haul loads. But it appears from the records, Plate XVII, that the long haul suburban routes earn, per seat-mile not much less than the short haul routes and average what would be a fair earning capacity for the entire system, 30c. per standard car-mile or 0.7c. per seat-mile. It seems reasonable, therefore, that service on the long haul suburban routes might be very generally improved by the methods above outlined.

Passenger Load. Many of the long haul cars are required to carry a short haul load. This indicates the necessity of running short haul trippers just ahead of the regulars as is now the practice of the Company in many cases, for example, Broad street to Thurbers and Norwood avenues. This plan is practically a necessity in absorbing loads developing suddenly, e. g., a 6 o'clock factory load. Here an evenly split

headway is ineffective, but for a peak load that *develops slowly*, extras spaced between the regulars are preferable as they permit of a regular headway of shorter period, which is a much greater convenience to patrons than a double or triple-header, and furthermore, lessen street congestion. Short haul trippers should not be required to run the entire route for the loading curves distinctly indicate where the short haul load drops off. By turning back at these points more trips can be run during the rush hour with the same equipment.

The only method of reserving seats for long haul rides is by means of limited stop expresses during rush hours. That this plan is quite effective is shown by the records of express trips wherein *practically all of the loading occurs within the terminal district*. This also furnishes evidence of the propriety of routing expresses, such as Buttonwoods, by through streets other than those devoted to local business, e. g., Eddy street. For the small number of persons thus discommoded who live along the local route (Broad street), can reach the express line by transfer to the first stopping point. In certain cases limited expresses need to be run only during rush hours, e. g., Washington Park via Eddy street, as at present.

On many of these counts, rush hour loads of approximately 200% of the seating capacity were observed, and it was not always the case that the heaviest loaded car of the day's trip happened to be selected for counting. This fact was determined by a comparison of the trip registration with that shown by the Company's trip cards for this particular line throughout the day. These same conditions were observed in the March counts. On the other hand, some of the routes on which maximum loading would be expected showed light loads,

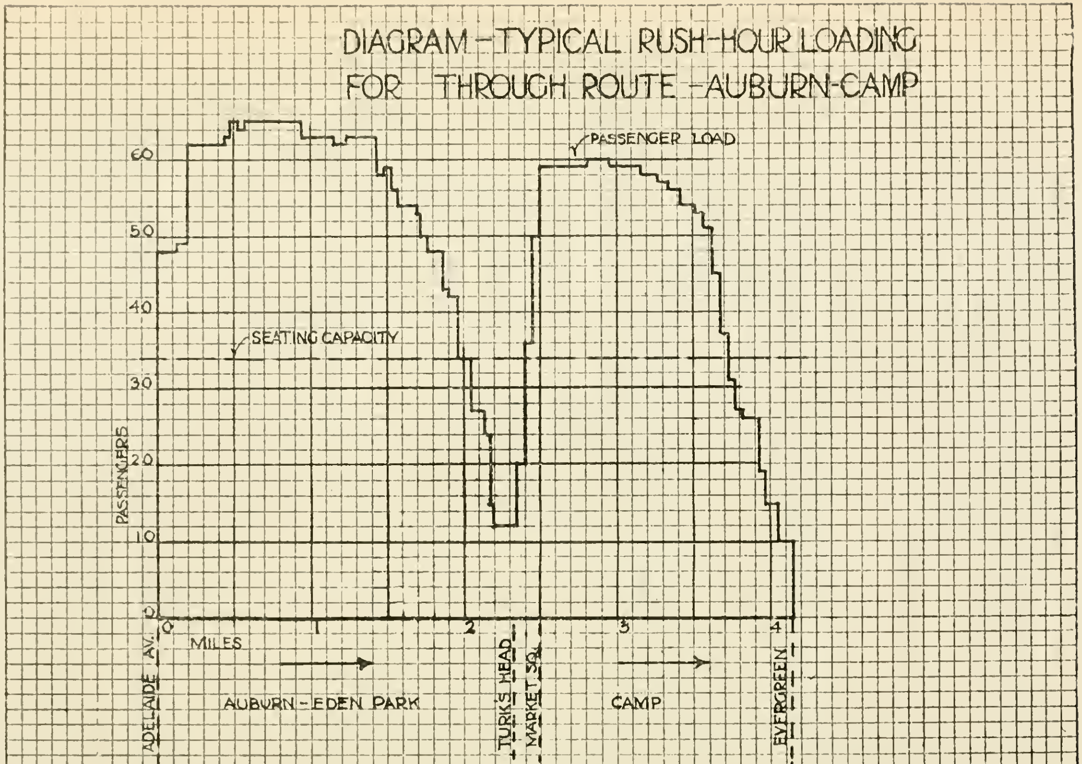


FIGURE 19—TYPICAL RUSH HOUR LOAD—THROUGH ROUTE.

A composite diagram showing the inbound and outbound loading of one of the through routes having heavy traffic. Only a small proportion of the total passengers continue their ride through the business centre. The heavy inbound load is due to outlying manufactories. This

e. g., Academy avenue. Ths illustrates the difficulty always encountered in anticipating the exact time these maximum rush hour loads occur.

Factory loads occasion the worst congestion; and on some routes very heavy loads occur on the first morning trip and also the last night trip. These loads can only be met by the present plan of trippers or extras. On some lines it appears that both rush hour outbound and later inbound loading could be served by the same extra runs so timed as to take advantage of load in both directions. The day loading, as a rule, is rather light—below seating capacity so that service generally reduces to a matter of headway.

It may be properly pointed out here that what is often considered as grossly excessive loading on through route cars is partly due to double loading. The Auburn-Camp line will serve as an example—Fig. 19. Here, heavy loads at rush hours were found in both directions, only twelve passengers continuing their ride through the city. On this trip the total registration was 125 passengers while the maximum in the car at any one time was 65 passengers. For the same reason lines passing through Olneyville often show an excessive high registration and a route such as Dyer Avenue-Swan Point actually shows triple loading. This is distinctly fortunate rather than the reverse, for it makes possible more service than if additional equipment had to be provided.

Stops. From 15% to 30% of the time is consumed in normal stops, the longer periods occurring on those lines where the frequent pole stops are taken advantage of, or else where the delays are excessive due to over-crowding. The average length of stops varies from 6 to 14 seconds, the latter on over-crowded

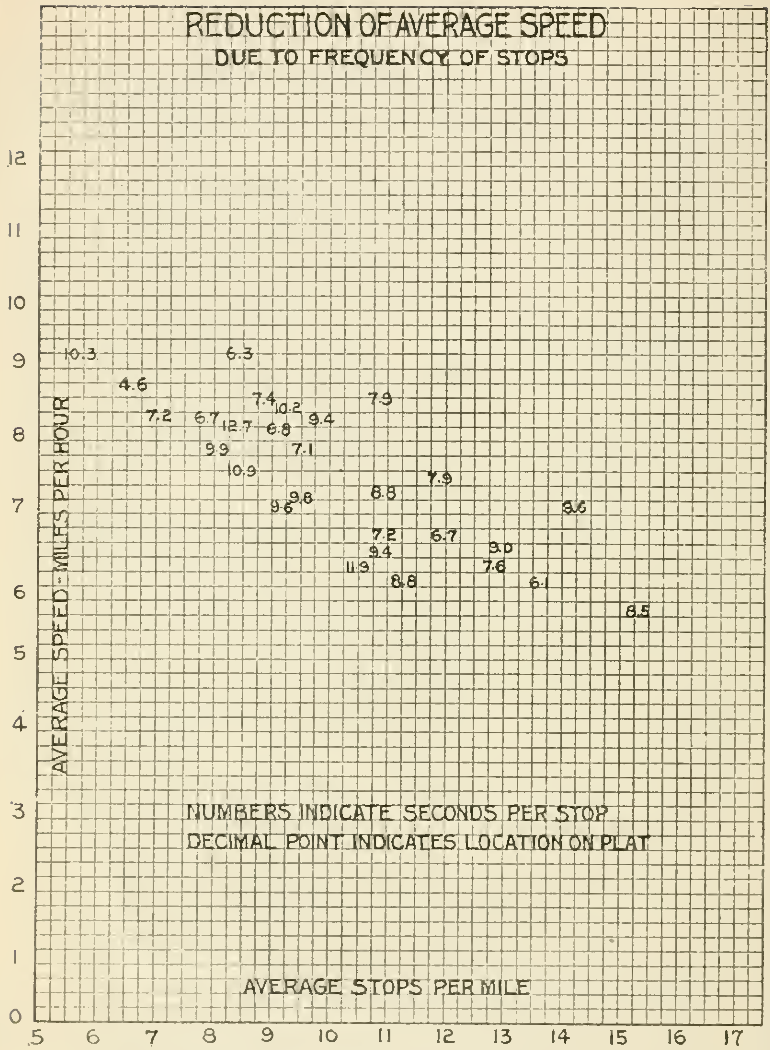


FIGURE 20—REDUCTION OF SPEED WITH STOPS.

Illustrating from a large number of observations in Providence how the speed is rapidly decreased with increased number of stops per mile, e. g., from 9½ miles with 5 stops, to 5.6 miles per hour with 15 stops. The figures indicate the average duration of stops and vary but little, showing that reduced speed is largely due to frequency of stops outside of the business district.

lines. Eliminating the stops, the average schedule speed on the longer lines is about 10 miles per hour, but, again, overcrowding reduces this to less than 8 miles on many lines, and including stops the average speed is reduced to 6 miles or lower. This relation is illustrated in Fig. 20. Attention must, therefore, be directed to: First, a reduction in the possible number of stops; second, a reduction in the delays from over-crowding; third, a reduction in the delays due to lack of promptness in handling of cars en route, exclusive of unavoidable delays in the terminal district.

The stops per mile vary from 8 to 17, averaging about 10 per mile or an average spacing of over 500 feet. Thus the pole spacing recommended in this report is somewhat less than the actual interval observed, which indicates that it should be sufficient to meet the needs of the average citizen and impose no hardship in the matter of extra walk. The increased running speed resulting will then be clear gain.

Headway. Insistent demands are being made for decrease in the headway on certain outlying lines and for still shorter headway during rush hours than is now being furnished. The accompanying car dot map, Plate XX, shows the regular headway during both day and rush hour and also the exact location of cars at 6 P. M. on various lines. On Pawtucket lines a rush hour headway of approximately five minutes is maintained. Broad street is also of about the same frequency to the Warwick avenue corners—ten minutes beyond. On single track lines, the headway varies from ten minutes on Prairie avenue, Friendship street, Admiral street and Chalkstone avenue to thirty minutes, e. g., on Hartford avenue, Charles street, etc., most of the lines having 20 minutes headway. One

line partly double tracked—Academy avenue has a five-minute headway at rush hours.

The frequency of car service should really be determined by the traffic density or riding habit of the patrons along the route. Consequently, lines of heavy traffice should always receive first consideration, as the interests of more people are involved. On the other hand, it is possible on light lines to discourage the riding habit of patrons by curtailing car service. For a given class of territory, there is an irreducible minimum of service even though the line must be operated at a loss. For any reasonably well developed residence territory, a rush hour headway of twenty minutes can hardly be considered adequate. While possibly sufficient for normal day traffic, it ought to be reduced during the rush hour. This undoubtedly involves more frequent turnouts; but the simple fact that streets are narrow should not prevent the more liberal provision of turnouts, but rather encourage it. Detailed recommendations regarding headway are made later in this chapter.

The outlying lines in thinly populated districts offer the greatest problem, and it often occurs that patrons of a light line branching from a heavy trunk line would receive better service if a shuttle line were adopted with a transfer to the trunk line rather than to run a through car to the city less frequently. The insistence of patrons who are not properly located for economical through riding from home to office is responsible, in most cities, for a good share of the difficulty in efficient routing. Surely, passengers should not object to transferring if the local headway could be decreased by means of a shuttle car and if a fairly close connection to the main line could be guaranteed with a comfortable ride on large cars for the balance of the trip.

It is not good practice to decrease an all day headway simply to accommodate occasional peak loads, as for convention halls, or playground, etc. Trippers should care for such patrons. No Company can afford to operate idle mileage all the time for occasional demands. Patrons desiring such special service would be most certain to get it by advising the Company of their needs prior to the demand.

Dead Mileage. Run-off or dead mileage represents that certain per cent. of the total revenue car mileage run that cannot be used effectively for revenue purposes, i. e., mileage lost when a car is turned into the car house from the outlying terminus on its last run. That every effort should be made to decrease this dead mileage is apparent from the fact that high dead mileage means less useful service for the same operating expense. For the entire Union Division the dead mileage is 4.48% (Table 19) or for the city lines only, excluding suburbans, 2.93%. This per cent. for the city, as a whole, is very reasonable, but certain lines might be improved: Thus, Centerdale via Smith, 11.9% which may be provided for by a short track connection from Smith Street to the Mount Pleasant car house; but Branch avenue, Charles street and Smithfield avenue lines, all above 10% in dead mileage, cannot readily be improved upon without a more convenient car house in the North End, as elsewhere suggested. Long haul suburban routes cannot avoid considerable dead mileage, especially those operated for short periods as extras. If the plan herein suggested were adopted; viz., having the last outbound trip of through routes turn in at the nearest car house, certain short track connections would be necessary, e. g., on the East Side, from the northern termini to the North Main street car house via Rochambeau and Pidge avenue, as later specified.

Through Routes. The Rhode Island Company is to be distinctly commended for the establishment of so many through routes. This is a development for which other cities are striving, some without success, unfortunately, owing to the mistaken idea of some managements that a through ride, even if a short haul, is a lost fare. The relative magnitude of this traffic in through routes, as compared with that of the entire system, are shown by the seat flow map, Plate XXI. Here the width of the lines is proportional to the number of seats passing during one hour. Within the down-town district the through routes only are shown.

The principal objection of some Railway Companies to establishing through routes seems to be on the possibility of exceedingly long rides for one fare. As a matter of fact, the percentage of such riding is so small as to be negligible. Observations made by the Rhode Island Company upon typical through routes in Providence show that Elmwood-Elmgrove line carried from one side of the loading district to the other only 50 to 100 people per day, while the Olneyville-Rumford-Phillipsdale lines carried from 175 to 250; Dyer Avenue-Swan Point, 70 to 100; Dexter-Douglas, 70 to 90; Elmwood-Chalkstone, 50 to 100. In the case of the Rumford route a definite community of interest exists, as many of the workers reside at Olneyville; but, in the case of many of the other runs, it is apparent that through riding from end to end is not a source of loss worth considering. For a short haul city like Providence, where the maximum through route ride is less than 7 miles, it should be eliminated from the discussion, the through routes being taken up entirely on the merits of more direct transit through the city. This point of view will be more evi-

dent from a study of the April route counts: Plates XIX A, B, C.

Through routes may be established for the following purposes: 1. To connect opposite sides of the city where there is an apparent community of interest. 2. To connect two loop lines of the same headway simply to facilitate transit through the street by avoiding loop congestion. 3. To encourage travel especially during non-rush hours, which is an element of clear gain to the operating company, as it is enabled to utilize more completely available equipment.

In general, the line originating in the south end of the city should continue to the opposite or north end, and vice versa, thus giving the most direct routing through the down-town district. Certain through routes, however, have been brought about by community of interest—such as Olneyville-Rumford-Phillipsdale, also an excellent example of the most direct through route is Olneyville-Rumford.

In Providence several through routes are split by operating ten minute headway on one side of the city and twenty minute on the other, alternating between the two branches.

A very considerable improvement might be made by having the last outbound car leaving one side of the city turn in at the car house on the opposite side, so as to give the patrons in those districts the advantage of the longer car service desired. At the present time some thirty minutes in the night service is cut off from the outlying territory, not adjacent to the car house now used, that might otherwise be provided without any hardship in operation.

An examination of the records of earnings per car-mile and per seat-mile show that, with a few exceptions, through routes

are practically all on a good paying basis, which is due largely to double loading, in some cases triple loading.

Destination Canvass.

In order to ascertain if possible the existence of communities of interest, not indicated by the various traffic counts on present routes, a canvass of several large manufactories was made, through the assistance of their respective officials, comprising number of employees, destination and preference of route. The results are presented in Table 21. Although full returns from this canvass are by no means available, these six factories will give some indication of riding habit. Thus practically half of the 3,200 employees of plants located near the center of the city walk to their work. About 20% of the Brown & Sharpe men transfer to the North End and Pawtucket. A large number also reside in Mount Pleasant, Olneyville, Arlington and Elmwood. Presumably these same conditions apply to the other mills along the bottom lands of the Woonasquatucket.

This, therefore, serves to confirm the necessity previously discussed, of a cross-town line via Valley-Huntington-Potters-Public on the one side and Orms street on the other to distribute the factory load between South Providence and Randall Square. This line would transfer one-half of the South Auburn workers to their homes without making it necessary to go to the center of the city. This also would be of direct benefit to nearly 40% of the riding employees of the Gorham Manufacturing Co., and also serve well the Olneyville mill workers living south of Westminster street. The East Providence workers, living in the direction of Olneyville, are now

provided with a direct line, but those residing in South Providence might clearly benefit by the proposed extension of the above cross-town route via Eddy street and Point street Bridge. All such diversion of traffic from the center of the city will eventually decrease the street congestion there, and is very desirable on this account. This study of destination should be carried to completion in the near future by a thorough canvass of the entire city as a part of a comprehensive re-routing study. The results, it is believed, would be of the greatest benefit.

SPECIFIC RECOMMENDATIONS.

Supplementing the above general discussion, certain definite improvements may be recommended which the records seem to indicate most necessary. Owing to the constant change in traffic, such recommendations on the service of individual routes very properly require verification by the Company by trial or observation.

TRACKAGE.

Certain track improvements have already been discussed under "City Planning." These are:

Constitution Hill	Double	Track
Randall street	"	"
Aborn street	"	"
Plainfield street	"	"
Steeple street	"	"
Smith street (to Chalkstone)	"	"

Fountain street ....Single track
Fenner street .... " "

Additional improvements essential to proposed plans for service improvements are as follows:

Chalkstone avenue. Double-track immediately with offside track location to Mt. Pleasant avenue. The diversion via Parkway and Promenade street that has been frequently suggested does not fulfill requirements as an alternative unless Smith street service were increased proportionately, for the major portion of Chalkstone avenue traffic centers on Capitol Hill.

Academy avenue. Double-track from Atwells to Chalkstone, offside location. A return loop is recommended via Chalkstone, Mt. Pleasant and Atwells avenues to meet double tracks on Atwells avenue. This would provide a complete independent track and reach more effectively the well settled Mt. Pleasant Plateau, also descending instead of climbing Atwell avenue hill. This plan might be modified by running every alternate or third trip up Academy avenue, returning as at present without traversing the loop.

Smith street. Double-tracking recommended in the very near future for Chalkstone avenue to Convent Hill with offside track location. As a 30-foot roadway will not quite accommodate four lines of traffic, it is better to reserve one side of the street for vehicles only, perhaps necessitating the shifting of the present track. This applies to the street irrespective of needed improvement east of Chalkstone avenue, which contemplates double track, center location, as discussed under "City Planning."

Friendship street. Extend single track to Dorrance street to establish northbound traffic exclusively on Friendship

street, at least below Chestnut street. This requires no turnouts and in any case the connection is needed for emergency routing.

Claverick street. Single track westbound connection from Friendship to Bassett streets relieving counter operation on South Providence lines.

Fenner street. Install track connection from Westminster to Broad. Double track preferable. Single track with turnout could be used.

Beacon avenue. Connect Broad street tracks with Friendship street, Prairie avenue and Ocean street lines, to provide all independent tracks north of Hayward Park.

Fountain street. Single track northbound connection from Aborn street through to West Exchange and Washington streets. This loop is very essential.

Plainfield Street. Double track immediately from Olneyville Square to Webster avenue. Extensions of the second track beyond Plainfield street to Webster avenue anticipates probable development by means of a line southward to Arlington. It is understood that the Company stands ready to construct whenever the Plainfield street grade separation is put into effect; but as the disturbance of track and grade will not extend over 500 feet in length, and at least another year will be required to get the grade separation under way, it is believed that this double tracking could be done now without hardship.

Olney street. A short connection from Camp to Hope streets will be of assistance in re-routing and in any case should be available for emergencies.

Admiral street Line. Extension from Douglas to Branch avenue appears, from passenger counts, to be desirable probably on account of the oblique street layout at this point not distributing as effectively as streets at right angles.

Dexter street. Passenger counts indicate extension southbound necessary and it is understood that this is contemplated in the Company's schedule of the season's improvements—if a suitable street is provided.

Reservoir avenue. Extend single track to Park avenue, with provision for double tracking.* Route Riverpoint express over this line instead of Elmwood avenue. Eventually extend Reservoir line southwesterly to develop this section.

Cranston street. Extend double track to Cranston Print Works (Haven avenue turnout.)

Washington Row. If some form of easy grade street approach to the East Side is adopted† a single track connection through Washington Row will be desirable to reach the entrance to the approach without encountering reverse curves on Canal street.

Academy avenue. Connection from car house to Smith street. This has been approved and should be built immediately.

Rochambeau & Pidge avenues. Possible connections westerly to North Main street car house.

Ocean street. Load curve indicates traffic north of Thurbers avenue. Extend track to railroad cut.

East Providence. Double-tracking of Broadway from Massasoit avenue to Warren avenue is already contemplated

† Particularly one which starts south of the center line of Canal street.
* This will require widening of the railroad bridge and approaches thereto.

by the Company to better serve the Providence and Riverside traffic from the north. Also double-tracking Taunton avenue to the state line with connections to Hunts Mills. These improvements are desirable. With a suitable East side approach in operation, Waterman avenue should also be double-tracked from Red Bridge to Broadway Six-corners.

Express Passing Tracks. A serious objection to the present express routes seems to arise from the fact that local cars are switched off on sidings to let the expresses pass, thereby losing considerable time in waits. In some cases, as on Eddy street, at Thurbers avenue and Public street, locals are shunted off the main line and backed into position after the express has passed. This is certainly a reasonable source of complaint which can only be removed by installing suitable passing tracks.

On Eddy street, already narrow, no room is available for additional side tracks without overhanging the curb. The only alternatives are: 1st,—double cross-over from outbound to inbound tracks and vice versa. 2nd—Shift track centers enough to provide room for one turnout. 3rd—Reduce sidewalk width at turnouts.

The first has the disadvantage of introducing counter operation on the return track, but this would not at present be serious on account of the small traffic on Eddy street. The second introduces reverse curves which are generally undesirable, especially occurring so often as would be necessary on Eddy street, where inbound and outbound turnouts would have to alternate in position along the street. The third is

questionable as Eddy street has already been narrowed. Temporarily, therefore, the double cross-over might be allowable, but, as the local traffic increases, proper provision for the necessary turnouts must be made in the future. On wide streets, such as outer Broad street and Broadway, passing tracks of ample length to avoid delays should be laid. This will result in imposing no hardship upon local passengers, and the express service will then achieve the double object of saving time and reserving seats for long haul passengers, while not interfering with the proper short haul service.

SERVICE.

Running Speed. A general increase in speed on most lines is so urgently needed that it is hardly necessary to specify particular ones. In many cases a liberal increase in speed will make it possible to realize the necessary increase in car mileage and reduction in headway with the present equipment. From the route counts it appears that 35 out of 59 or nearly 60% of the trips were below schedule, even when making allowance for extraordinary delays such as the Smith street turnouts. Moreover, there were 23 trips observed in which the average speed outside of the loading district was under 8 miles per hour, i. e., where free running was possible. Examples of present actual conditions may be cited on the following lines: Brown-Mathewson—4.69 m. p. h., Friendship—4.73 m. p. h., Camp—Prairie—5.29 m. p. h., Arlington & Ocean—5.63 m. p. h., Broadway—5.86 m. p. h.

An average speed, deducting time of stops, of at least 10 miles per hour should be operated, or 12 miles on free running lines. This would raise the average schedule speed, including stops, to 8.5 or 9 miles per hour, depending upon the number of stops, as compared with the present average of 7.96 for the entire Union Division. That such increased speed is possible is proven by the experience of other cities where even faster schedules are in force.

Delays. Losses in running time during the rush hours, from 2 to 10 minutes in duration were observed on a number of trips, the most serious of which are as follows:

Chalkstone—10¼ min.—Smith & Chalkstone turnouts.

Oaklawn—9 min.—Print Works turnouts.

Phillipsdale—9 min.—Red Bridge & Six Corners turnouts.

Smith Street—5 min.—Chalkstone turnouts.

Centerdale (Smith)—4½ min.—Chalkstone turnouts.

Manton—2¾ min.—Olneyville turnouts.

Hope—2 1-3 min.—Cypress turnouts.

Butler—2 1-3 min.—Market Square turnouts.

Of the above Smith Street and Print Works most need improvement. Both have been covered by recommendations for double tracking. Undoubtedly delays will be encountered on other lines, elimination of which will require the most rigid despatching and better locations of turnouts, if double tracking is not now warranted.

Headway. The reasonable capacity of regular headway appears to have been reached on a number of lines such as Oaklawn, Print Works, Riverside, Auburn & Eden Park, Broadway (Rumford), Rumford, Edgewood via Eddy, Prairie and Dyer avenue. This statement is made on the assumption

that a practically seated load is to be maintained during hourly intervals through non-rush hours, and it presumes that occasional standing loads will occur. These conclusions, of course, cannot be regarded as final without further observation through various seasons, but the increased loading of winter would tend to confirm them.

*Trippers and Extras**. It is hardly feasible to specify in detail all the additional rush hour service necessary for the reason that the increased speed recommended will completely upset the present schedules. However, certain more important present needs may be mentioned: Cranston Print Works—more morning rush trippers to relieve Oaklawn and Knightsville; Union avenue—rush hour extras; Centerdale via Smith—more short haul rush extras; Hope street—more rush extras to Rochambeau avenue; Chalkstone avenue—short haul extras to Davis Park would relieve much local load on Capitol Hill during rush hours; certain lines such as Branch avenue and Douglas avenue show heavy loading in the first morning trips which could be relieved by either trippers or earlier starting. It must be remembered in discussing this feature of the service that the Rhode Island Company is now giving double service during rush hours, i. e., 100% above the service of non-rush hours. This is admittedly all that can reasonable be required, *provided always* that the non-rush hour service meets the proper standard.

Expresses. More definite recommendations can be made concerning this branch of the service: Riverpoint expresses should be routed via Reservoir and Park avenues. Button-

* Trippers here understood as special cars just preceding regulars. Extras meaning special cars run between regulars on split-headway.

woods (via Broad) should be diverted from upper Broad street at least during rush hours and re-routed via Eddy street giving Broad street patrons transfers to the express at Warwick avenue junction. This change in routing will reduce to some extent the rush hour standing load on this line and will involve a slight extension of the transfer privilege, but this may very properly be in the form of an exception to the present system for express patrons only.

Auburn & Eden Park route needs express and short haul trippers running during rush hours to relieve the long haul standing. East Greenwich express should run express inbound as well as outbound in order to be relieved of City load which is now superimposed upon a heavy rush hour Auburn load. The latter is especially heavy inbound.

Oaklawn needs rush hour express with short haul extras to Knightsville. Hughesdale similarly should run express with rush trippers to Silver Lake. Centerdale (via Manton) should run express through Olneyville.

An auxiliary rush hour route from Olneyville to Centerdale might be suggested to relieve Manton avenue cars.

Pawtucket service would be improved by express and more rush trippers to Pidge avenue. Riverside requires express and short haul extras to Pawtucket avenue.

Short Haul Expresses. It has been proposed by residents of Mt. Pleasant to operate certain cars on Academy avenue route as expresses, running through the Federal Hill district to Harris avenue before stopping. The demand for this route is not based upon a desire for greater speed, but purely to reserve sufficient seats for Mt. Pleasant passengers. The

plan is opposed by Federal Hill residents on the ground of curtailing the service.

From the results of passenger counts, both for the outlet throat and for a typical trip, it appears that the Federal Hill local load is not as severe as might be inferred from the density of population, for the reason that the great majority of workers do not seem to use the cars habitually. The load curve, of which Plate XX is typical in shape only, shows that most of the load is through load to Mt. Pleasant and that there is rather less superimposed on this than on other lines.

It seems, therefore, in view of the short haul and the facilities for improved service when the Mt. Pleasant loop is installed, that the express service is not only unnecessary, but also inadvisable, from the standpoint of discrimination.

Express service should only be regarded as a necessary means for overcoming the handicap of distance and limited thoroughfares. It necessarily introduces a classification of passengers into long haul and short haul. This apparent discrimination is obviously not of the same order as that embodied in the Mt. Pleasant express idea, in which the element of distance is not predominant. It is believed that the express idea should at present be limited to the long haul suburban routes of the 5c. zone.

APPENDIX

RECORDS OF THE RHODE ISLAND COMPANY

TABULAR DATA

THE RHODE ISLAND COMPANY.

Organization, Territory and Equipment.

In brief, the present surface traction system is constituted as follows: (See analysis of ownership, Table 1.)

The Rhode Island Company is an operating Company, chartered in 1902, operating mostly within this State. Its stock is controlled by the New York, New Haven & Hartford Railroad Company through a holding company, the Providence Securities Company. The Rhode Island Company owns the Woonsocket local and interurban and contiguous lines, all acquired in 1907; it leases the Union Railroad Company and Pawtucket Street Railway Company, both since 1902, and the Rhode Island and Suburban Railway Company since 1904.

The Union Railroad Company prior to the lease of the Rhode Island Company operated all of the street railways in Providence, including the Providence Cable Tramway Company, which it leased in 1895; this company operated only about three miles of route on the East side, principally the College Hill approach.

Mileage. A complete map of single and double track within the Providence District is shown in Plate 1. For the year 1910 the mileage of the system was reported to local and state authorities as follows, all single track:

City of Providence, exclusive of turnouts and car house tracks 88.68

Union Railroad Division, exclusive of turnouts and car house tracks 152.74
Rhode Island system within the State 317.28

Double track within the City aggregates 19.2 miles or 21.75% of the total.

Suburbans. There are a number of long distance interurban systems entering Providence, all of them over the lines of the Rhode Island Company, as follows:

Foreign lines.		Lines operated by Co.
Fall River	via E. Providence	Woonsocket
Taunton		Riverpoint
Danielson		East Greenwich
Attleboro	via Pawtucket	Buttonwoods via Broad street
No. Attleboro		Buttonwoods via Elmwood Ave.
So. Attleboro		Warren & Bristol
Worcester		

Fares. The limits of the City and suburban fare zones are outlined by means of contour zones in Plate II. On all the independent lines the Rhode Island Company receives the first fare to about the City line, and to the outside City lines of Pawtucket and East Providence. Hence, these suburban connections may be regarded as part of the local service.

The suburban system operated by the Rhode Island Company has extended southward through the shore towns to Warwick, Buttonwoods and East Greenwich; to the southwest through the Pawtuxet Valley towns, Thornton and Hughesdale; northward to Centerdale along the Woonasquatucket River; also southward along the east shore to Riverside, Warren and Bristol.

UNION RAILROAD DIVISION.

The limits of the Union Railroad Division may be defined in general as practically identical with the five-cent zone, i. e., up to the Providence City line, with the following exceptions, all of which are indicated by coding on the map of the Division, Plate V: In North Providence—Branch avenue to Woodville; Smith street to Centerdale; Plainfield street to Hughesdale; Cranston street to Oaklawn; Elmwood avenue to Auburn and Eden Park; Broad and Eddy streets to Edgewood and Pawtuxet; and all East Providence lines to the City line, except to old Barrington Road on the Riverside line. On account of this extension beyond the city lines it has been desirable to base certain calculations regarding service upon the five-cent zone instead of the city limits.

Income Account. Annual fiscal reports of the Company to the Railroad Commissioners furnished the basis of the analysis of income, Table 2, and shown graphically on Fig. 9.

Traffic. Detailed operating records are not available prior to the calendar year 1907, during which the property was taken over by the present management. These records comprise car miles, passenger earnings, total passengers carried and car mile ratios, that is, passengers and earnings per car mile. See Figs. 7 and 18, Tables 7 and 17.

Service. The basis of all analysis of service furnished during the winter season is given by the winter schedule. Table 20, which represents the standard to which the Company endeavors to adhere during this season. This schedule gives the actual assignment of seating capacity and headway for the various routes in detail.

Taxes. The City of Providence taxes the Union Railroad franchise on the basis of its earnings in Providence. Table 3 gives these taxes in detail since 1893. The gross earnings assignable to Providence are determined by prorating all the earnings of the Union Railroad Division to the earnings within Providence in proportion of the total miles of single track to the mileage within the City. Upon these earnings the Union Railroad paid up to 1897 3% of its gross earnings and 5% since then. An additional property tax increased the total imposed by the City to 7.1% of the gross earnings within the City for 1910. Table 4 gives the taxes and earnings in detail since 1893. This percentage of total city taxes had gradually increased year by year from about 6.5% ten years ago.

Power. The lines of Providence and vicinity are all served from a single power station of 16,300 k. w. capacity, located at Manchester and Eddy streets on tide water. From this point both positive and negative copper radiates in all directions, the longest one-way distribution being to Esmond and to Oaklawn, about seven miles distant. All power is transmitted through overhead trolley system, except the mechanical counterbalance up the College Hill grade.

Alternating current is generated at this station in addition to direct current for transmission at 11,000 volts to suburban sub-stations of the Rhode Island Company at Westcott, Riverview, Attleboro, Pawtucket, and Barrington. An A. C.-D. C. rotary converter is also installed at the power station in order that the local direct current distribution may be assisted from the alternating current end in times of peak load. To minimize the electrolysis, negative copper returns are installed

from such important points as Olneyville Square, Cranston, Edgewood, Auburn, Smith and Branch avenues, and to Broadway Six Corners and Riverside, the last a distance of about seven and a half miles.

Car Houses. Of the nine operative car houses, seven are for the City service and two for the suburbans. (See Equipment Table 14). All other lines are served in barns of independent companies. The total capacity of the city car houses is about 600 cars. Practically half of the storage capacity of the newer barns is reserved for off-season equipment.

Rolling Stock. For the entire system a total of 828 cars was reported in 1910, approximately half of which represent open summer cars (see Equipment Table 10). The winter schedule for the Union Division calls for 331 cars, while 410 cars are now available (including the fifty new box cars) for winter and 353 for summer. The balance, 79 cars, are used outside of Providence or held in reserve. Neglecting the equipment assigned to the Providence & Burrillville Ry., (10 cars), out of the 753 cars on Union Division, although half of them are winter cars, the seating capacity represented is less than two-thirds of the summer equipment. Furthermore, out of the entire rolling stock for Providence District, 25% of the cars are of the old single truck type aggregating only 16 2-3% of the total seating capacity. The new Bradley equipment recently placed in service represented an increase of 18.2% of the winter seating capacity.

TABLE 1.

ANALYSIS OF OWNERSHIP.

THE RHODE ISLAND COMPANY.

New York, New Haven & Hartford Railroad Company
owns

Providence Securities Company (holding company)
owns

Rhode Island Company (operating company chartered April 13, 1902)

1—Owns

Woonsocket Street Railway (purchased in 1907)
Providence & Burrillville Railway (purchased in 1907)
Columbian Street Railway (purchased in 1907)

2—Leases

Pawtucket Street Railway (leased in 1902)
Rhode Island Suburban Railway (leased in 1904)
Union Railroad Company
leased

Providence Cable Tramway Company (leased in 1895)

Report-City of Providence.
Authority-American Street Railway Investments.

LYSIS OF RHODE

ON PERC

1904.	
$2,754,655.39	$3,
2,703,115.00	3,
98.2	
$608,671.00	$
1,066,691.00	1,
38.7	
$1,675,363.00	$1,
60.8	
$167,137.00	$
6.1	
$1,842,500.00	$2,
66.9	
$742,862.00	$1,
27.0	
....	...
....	....
$169,293.(a)	$
912,155.(a)	1,
33.1	
$92,054.00	$.
151,570.00	
243,624.00	
8.9	
54,484,754.00	62,
257.64	
692	
4.97c	
5.05c	
$10,690	

(b) Basis of Comp

TABLE 2

TABLE 2.

ANALYSIS OF RHODE ISLAND COMPANY'S RETURNS FOR RHODE ISLAND

On Percentage of Income—Year Ending June 30th.

	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	
Receipts from all sources	$2,584,153.57	$2,754,655.39	$3,242,972.54	$3,561,242.29	$3,859,715.15	$4,217,022.57	$4,192,957.94	$4,502,922 69	
Passenger Receipts	2,537,623.00	2,703,115.00	3,123,124.00	3,435,968.00	3,734,524 00	3,958,708.00	3,892,059.00	4,170,326.00	
Percentage	98.2	98.2	96.4	96.5	96.8	93.9	92.8	92.6	
General Operating Expense, including Maintenance	$703,426.00	$608,671.00	$557,420.00	$625,103.00	$2,419,221.00	$772,310.00	$818,332.00	$964,391.00	
Salaries and Wages	948,353.00	1,066,691.00	1,303,567.00	1,277,529.00		1,801,364.00	1,495,622.00	1,573,295 00	
Percentage	36.7	38.7	40.2	35.9		42.7	35.6	34.9	
Total	$1,651,779.00	$1,675,363.00	$1,860,987.00	$1,902,632.00	$2,419,221.00	$2,573,674.00	$2,313,954.00	$2,537,686.00	
Percentage	63.9	60.8	57.4	53.4	62.7	61.1	55.2	56.3	
Taxes	$142,955.00	$167,137.00	$205,832.00	$256.398.00	$260,311 00	$286.997.00	$289,292.00	$300,683.00	
Percentage	5.5	6.1	6.3	7.2	6.7	6.8	6.9	6.7	
Operating Expenses and Taxes	$1,794,735.00	$1,842,500.00	$2,066,819.00	$2,159,031.00	$2,679,532 00	$2,860,671.00	$2,603,248.00	$2,838,369.00	
Percentage	69.4	66.9	63.7	60.6	69.4	67.9	62.1	63.0	65.37
Rentals	$757,306.00	$742,662.00	$1,050,142.00	$1,057.405.00	$1,070.481.00	$1,061,642 00	$1,065,792.00	$1,065,792.00	average
Percentage	29.3	27.0	32 4	29.7	27.7	25.2	25.4	23 6	
Dividends	....		......	.....	....	....	$425,520.00	$510,624.00	
Interest	....	......	....	...	$10,889.00	$116,288.00	54,711.00	25,196.00	
Surplus	$32,112.(a)	$169,293 (a)	$126,011.00	$344.807.00	498,813.00	178.421.00	43,687.00	62,941.00	
Total	798,418.(a)	912,155 (a)	1,176,153.00	1,402,212.00	1.183,183.00	1,356,351.00	1,589,710.00	1,664,553.00	
Percentage	30.0	33.1	36.3	39.4	30.6	32.1	37.9	37.0	
Maintenance of Way	$133,211.00	$92,054.00	$115,700.00	$142,054.00	$336.516.00	$260,452.00	$189,295.00	$292,686.00	
Maintenance of Cars	167,967.00	151,570.00	197,860.00	201,604.00	224,321.00	286,057 00	225,283.00	217,409.00	
Total	301,178.00	243,624.00	313,560.00	343,658.00	560,837.00	546,509.00	414,578.00	510,095.00	
Percentage	11.6	8.9	9.7	9.7	14.5	12.9	9.9	11 3	
Revenue Passengers	51,113,851.00	54,484,754.00	62,763,002.00	68,609.556.00	66,404.782.00	80,173,643.00	77,609,378.00	82,792,929.00	
Single Track Mileage	249.96	257.64	262.87	265.14	307.59	313.55	315.76	317.28	
Number Passenger Cars	682	693	725	765	824	829	823	828	
Passenger Earnings per Revenue Passenger	4.97c	4.97c	4.9[illegible]c	5.00c	5.62c(b)	4.94c	5.01c	5 03c	
Gross Earnings per Revenue Passenger	5 06c	5.05c	5 17c	5.19c	5 82c(b)	5.26c	5.41c	5.44c	
Total Receipts per mile of single track	$10,340	$10,690	$12,340	$13,450	$12,530	$13,470	$13,290	$14,290	

(a) Computed. (b) Basis of Comparison questionable.

Report-City of Providence.
Authority-Railroad Commissioner Reports

TABLE 3.

RECORD OF GROWTH OF RHODE ISLAND COMPANY

For Union Railroad Company and City of Providence.

Calendar Year.	Gross Earnings from Operation Union R. R. Division.	City of Prov.	Single Track Operated Union R. R. Division.	City of Prov.
1893	$1,122,224.66	$730,691.39	64.44	40.55
1894	1,346,835.81	773,011.89	69.72	43.16
1895	1,460,879.19	874,043.07	73.40	44.98
1896	1,507,787.93	921,531.22	77.93	46.96
1897	1,515,908.31	906,047.61	77.93	46.96
1898	1,552,934.63	945,393.43	83.93	50.71
1899	1,754,653.15	1,042,172.66	84.40	51.28
1900	1,953,798.53	1,158,588.54	121.43	73.93
1901	2,178,101.23	1,308,333.82	130.20	77.00
1902	2,221,943.23	1,313,491.57	131.19	77.99
1903	2,444,795.95	1,453,976.33	135.95	81.14
1904	2,536,351.57	1,501,950.62	138.04	81.16
1905	2,681,436.68	1,568,370.73	140.10	81.82
1906	2,849,884.64	1,689,495.53	145.42	84.82
1907	3,099,530.38	1,796,960.13	149.48	86.44
1908	2,966,151.24	1,723,551.38	151.30	88.30
1909	3,121,016.32	1,817,929.51	152.74	88.68
1910	3,315,149.97	1,923,625.69	152.74	88.68

Report-City of Providence.
Authority-Rhode Island Co.

TABLE 4.

TAXES PAID BY RHODE ISLAND COMPANY IN CITY OF PROVIDENCE.

Union Railroad Division.

Calendar Year.	Franchise.	Property.	Total.	Percent. Gross Earnings.
1893	$21,920.72	$10,101.44	$32,022.16	4.38
1894	23,190.33	13,973.76	37,164.09	4.79
1895	26,231.29	15,594.24	41,825.53	4.79
1896	27,167.32	16,089.48	43,256.80	4.70
1897	27,181.43	16,564.35	43,745.78	4.83
1898	45,329.38	18,946.29	64,275.67	6.80
1899	48,721.27	18,847.62	67,568.89	6.48
1900	54,728.04	21,054.44	75,782.48	6.55
1901	62,427.48	22,279.36	84,706.84	6.48
1902	62,779.14	23,149.44	85,928.58	6.53
1903	69,526.31	23,386.11	92,912.32	6.39
1904	71,908.76	24,889.26	96,798.02	6.45
1905	75,066.73	38,307.72	113,374.45	7.23
1906	80,925.75	38,252.61	119,178.36	7.07
1907	86,172.05	40,142.85	126,314.90	7.03
1908	82,737.54	43,671.87	126,409.41	7.34
1909	87,303.50	43,920.36	131,223.86	7.24
1910	92,394.01	43,980.42	136,374.43	7.10
	$1,045,711.05	$473,151.62	$1,518,862.67	

Report-City of Providence.
Authority-Rhode Island Company.

TABLE 5.

EARNINGS PER CAPITA—RHODE ISLAND COMPANY SYSTEM.

	Earnings.	Population.	Earnings Per Capita.
1900...		359,944	
1903...	$2,584,453.00	383,000 (Est.)	$6.75
1905...	3,242,972.00	407,171	7.97
1910...	4,502,922.00	465,983	9.67
1915...	5,515,000.00 (Est.)	515,000	10.70
1920...	6,720,000.00	569,000	11.80
1925...	7,970,000.00	620,000	12.85

The population of the following towns and cities is included in the above statement:

Barrington
Bristol
Burrillville
Central Falls
Cranston
Cumberland
East Greenwich
East Providence
Johnston
Lincoln
North Providence
North Smithfield
Pawtucket
Providence
Smithfield
Warren
Warwick
Woonsocket

Report-City of Providence.

Authority-U. S. Census.

TABLE 6.

GROSS EARNINGS PER MILE OF TRACK IN PROVIDENCE.

BASIS OF SINGLE TRACK.

Calendar Year.	Gross Earnings per mile, single track
1893	$18,000
1894	17,890
1895	19,420
1896	19,590
1897	19,260
1898	18,620
1899	20,300
1900	15,640
1901	16,970
1902	16,830
1903	17,920
1904	18,490
1905	19,160
1906	19,900
1907	20,760
1908	19,520
1909	20,460
1910	21,960

NOTE: Includes Johnston annexation and lines of Providence Cable Tramway.

Earnings per mile of track for Union Division practically indentical owing to method of prorating City Earnings on a basis of single track mileage within or without the City limits.

Authority-City Records.

TABLE 7.

MONTHLY RECORD OF CAR MILEAGE OPERATED—UNION DIVISION 1907-1910

Month.	Revenue Car Miles Actual.	Passenger Earnings per Car Mile.	Total Passengers per Car Mile.	Uniform Month.† Revenue Car Miles.	Uniform Month.† Total Passengers.
1907	$9,538,512	$31.99	7.50	$9,538,500	71,450,000
Jan.	747,827	29.55	6.82	731,800	4,990,000
Feb.	669,205	29.79	6.89	726,600	5,005,000
Mar.	753,957	30.43	7.02	739,800	5,195,000
April	751,762	31.02	7.18	761,900	5,470,000
May	813,399	32.37	7.57	798,000	6.040.000
June	839,012	34.65	8.15	850,300	6,930,000
July	911,667	36.13	8.57	894,200	7,660,000
August	904,269	35.80	8.45	888,700	7,508,000
Sept.	811,308	32.01	7.60	822,000	6,245,000
Oct.	790,675	30.85	7.29	776,000	5,655,000
Nov.	762,574	30.05	7.07	773,000	5,465,000
Dec.	782,857	29.16	6.84	768,400	5,255,000
1908	9,070.234	31.94	7.58	9,070,200	68,750,000
Jan.	749,881	28.09	6.63	735,600	4,876,000
Feb.	691,271	29.78	7.04	724,600	5.100,000
Mar.	723,910	28.92	6.85	710,200	4,864,000
April	704,208	30.95	7.30	713,800	5,210,000
May	759,378	33.71	8.00	745,200	5,960,000
June	792,380	35.40	8.42	803,400	6,760,000
July	840.862	34.53	8.29	825,400	6,821,000
August	838,775	33.74	8.12	824,500	6,693,000
Sept.	770,227	32.85	7.85	780,500	6,126,000
Oct.	752,632	31.69	7.49	738,400	5,535,000
Nov.	707,833	31.02	7.31	717,400	5,223,000
Dec.	738,877	31.44	7.35	724,900	5,328,000
1909	9,106,091	33.29	7.88	9,106,100	71,750,000
Jan.	721,635	29.81	7.03	707,900	4,975,000
Feb.	652,595	30.83	7.28	709,200	5,160,000
Mar.	729,736	29.85	7.05	715,800	5,045,000
April	721,923	32.01	7.54	731,600	5,508,000
May	779,413	34.06	8.08	764,400	6,176,000
June	794,376	36.28	8.62	805,300	6,940,000
July	849,382	36.14	8.62	833.400	7,191,000
August	843,308	35.63	8.55	827,600	7,073,000
Sept.	777,847	34.22	8.12	788,300	6,400,000
Oct.	755,618	33.40	7.89	741,500	5.850,000
Nov.	727,305	32.94	7.77	736,800	5,724,000
Dec.	752,953	32.81	7.66	748,800	5,738,000
1910	9,427,789	34.07	8.10	9,427,800	76,300,000
Jan.	749,171	31.77	7.53	734,800	5.535,000
Feb.	686,430	31.34	7.42	745,700	5.529,000
Mar.	767,448	31.37	7.41	752.500	5.577,000
April	759,798	32.79	7.74	770.000	5,960.000
May	805,521	34.48	8.21	790,000	6,492,000
June	792,574	36.42	8.67	803,400	6.960.000
July	876,331	37.38	8.96	861,600	7,719,000
August	852,560	36.03	8.66	836,600	7,240.000
Sept.	806,233	35.15	8.41	817,200	6,870,000
Oct.	786,470	34.33	8.15	772.000	6,288,000
Nov.	755,617	32.88	7.80	765,800	5.973,000
Dec.	789,636	33.66	7.92	774,600	6,134.000

Authority-Rhode Island Co. † Computed to four figures only.

TABLE 8. SUMMARY OF THROAT COUNTS—OUTBOUND—5:30 TO 6:30.

	Broadway & Federal	Westminster & Cranston	Broad & Winter	No. Main & Mill	Wickenden & Traverse	College Hill	Manchester & Eddy	Francis & Promenade	Friendship & Chestnut	Total
Cars Passing	29	61	57	52	33	32	25	19	25	333
2nd count	31	61	56	52						
Seats	932	1,898	2,144	1,946	1,074	832	866	630	714	11,036
2nd count	966	1,908	2,134	1,941						
Passengers	1,332	2,753	2,851	2,291	1,513	1,191	1,145	928	726	14,730
2nd count	1,344	2,747	2,874	2,294						
Passengers Standing	400	855	707	345	439	359	279	298	12	3,694
2nd count	378	839	740	353						
Schedule Cars	37	58	59	54	29	33	23	22	20	335
Schedule Seats	1,162	1,804	2,240	1,962	1,002	858	782	724	568	11,102
Schedule Headway	1′-37″	1′-2″	1′-1″	1′-7″	2′-4″	1′-49″	2′-36″	2′-44″	3′	
% Schedule Cars (Avg.)	78.4	105.3	96.8	96.3	113.8	97.1	108.8	86.4	125.0	99.5
% Schedule Seats (Avg.)	80.3	105.4	95.6	99.1	107.2	96.8	110.8	86.9	125.5	99.3
% Loading (average)	143.0	144.5	132.8	118.0	140.8	143.0	132.2	147.2	101.8	133.5
Average Headway	2′	59″	1′-4″	1′-9″	1′-49″	1′-52″	2′-24″	3′-9″	2′-24″	
Minimum Headway	30″	5″	0″	0″	10″	0″	15″	30″	0″	
Maximum Headway	6′-30″	3′-45″	6′-30″	5′	6″	8′-45″	11′-45″	7′-45″	6′-30″	
Date of Count	Mar. 7-15	Mar. 7-10	Mar. 7-13	Mar 8-14	Mar. 8	Mar. 8	Mar. 7	Mar. 9	Mar. 9	
Duration	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour	
Observers*	K.&E.	M.&N.	D.,R.&T.	D.,E.&T.	M.&N.	K.&R.	P.	M.&R.	K.&N.	
Weather	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	
Temperature	Cold	Cold	Cold	Mod.	Mod.	Mod.	Cold	Mod.	Mod.	

Report—City of Providence.

Authority—Rhode Island Co. and Counts.

*M.—Sergeant Maguire
D.—Sergeant Day
K.—Sergeant Kent
E.—F. E. Edgecomb

R.—W. W. Reynolds
N.—L. D. Nisbet
P.—C. D. Putnam
T.—C. S. Titus

TABLE 9. ANALYSIS OF SERVICE—5:30 to 6:30 P. M.—THROATS—OUTBOUND ONLY.†

Throats.	Interval.	Westminster & Cranston	No. Main & Mill	Broad & Winter	Broadway & Federal	College Hill	Wickenden & Traverse	Francis & Promenade	Friendship & Chestnut	Manchester & Eddy	Total City
Cars passing	10 min.	8.	6.	6.	8.	3.	6.	2.	4.	2.	40.
	10 "	6.5	7.	7.5	5.	6.	4.	3.	4.	2.	45.
	10 "	9.	5.5	8.5	4.	5.	3.	3.	4.	2.	44.
	10 "	7.5	9.	8.5	4.	4.	3.	3.	3.	5.	47.
	10 "	16.	14.5	10.5	6.5	7.	6.	6.	2.	7.	75.5
	10 "	13.5	10.	15.5	8.	7.	9.	2.	8.	6.	79.
Seats	10 min.	245.	206.	211.	94.	78.	200.	68.	112.	68.	1282.
	10 "	213.	279.	291.	154.	156.	142.	94.	112.	68.	1509.
	10 "	293.	204.	330.	120.	130.	110.	102.	120.	68.	1477.
	10 "	236.	338.5	332.	128.	104.	102.	94.	86.	186.	1606.5
	10 "	497.	533.	397.	207.	182.	212.	204.	52.	254.	2538.
	10 "	419.	383.	577.	244.	182.	308.	68.	232.	222.	2635.
Passengers	10 min.	304.	210.	270.	125.5	100.	214.	132.	126.	85.	1566.5
	10 "	293.5	328.5	397.	204.	185.	156.	84.	128.	108.	1884.
	10 "	389.	245.	427.5	156.5	160.	172.	138.	116.	84.	1888.
	10 "	348.5	337.	449.	192.	163.	150.	127.	103.	246.	2115.5
	10 "	806.	712.	574.5	336.5	285.	340.	339.	51.	300.	3744.
	10 "	609.	460.	744.5	325.	298.	481.	108.	202.	322.	3549.5
% Loading	10 min.	124.0	101.9	128.0	133.5	128.3	107.0	194.2	112.5	125.0	122.2
	10 "	137.7	117.7	136.3	132.5	118.5	109.8	89.4	114.2	158.9	124.9
	10 "	132.8	120.1	129.5	130.3	123.0	156.3	135.2	96.7	123.5	127.8
	10 "	147.7	99.6	135.2	150.0	156.6	147.0	135.2	119.8	132.2	131.7
	10 "	162.2	133.6	144.7	162.5	156.5	160.3	165.2	98.1	118.1	147.6
	10 "	145.4	120.2	129.0	133.2	163.7	156.2	158.8	86.7	145.0	134.7
% Loading	20 min.	130.2	111.0	132.9	132.3	121.8	108.2	133.3	113.3	142.0	123.6
	20 "	139.4	107.3	132.4	140.5	137.9	151.9	135.2	106.3	129.9	129.8
	20 "	154.5	128.0	135.4	146.7	160.1	158.0	164.4	89.1	130.7	141.0
% Loading	30 min.	131.3	113.7	131.6	132.1	122.2	120.1	134.0	107.5	135.7	124.9
	30 "	153.0	120.3	135.3	147.4	159.4	156.0	156.8	96.2	131.2	138.8
% Loading	Rush Hour	144.5	118.0	134.0	141.4	143.1	140.9	147.2	101.6	132.2	133.5

† For first series of counts only.

TABLE 10. SCHEDULE OF ROLLING STOCK RUNNING IN OR INTO THE CITY OF PROVIDENCE.

Class Box or Open.	Number of Cars. Cross Seat.	Long Seat.	Capacity Seated Load.	Type of Seat.	Average Weight Equipped.	Maximum Dimensions. Length Overall.	Over Corner Posts.	Width Overall.	Vestibule Length Over Bumpers.	Trucks.	Brakes.	Number of Motors.
1-B		106	26	Long	17,000	28′-8″	19′-6″	7′-7½″	55″	Single	Hand	2
2-B		5	28	Long	22,000	30′-6″	21′	8′-2¾″	63″	Single	Hand	2
3-B		(a)22	34	Long	32,000	35′-2½″	25′-6″	8′-3½″	59″	Double	Hand	4
4-B		14	34	Long	31,700	34′-6″	25′-2″	7′-8″	56″	Double	& Air	4
5-B		117	34	Long	34,000	35′-9″	25′-6″	8′-4½″	62″	Double	"	4
6-B	24		36	Cross	36,200	35′-9″	25′-6″	8′-9½″	62″	Double	"	4
7-B	4	(b) Pas.	30									
		Bag.	7	Cross	48,000	30′-9″	31′	8′-9½″	59″	Double	"	4
8-B		20	40	Cross								
				& Long	47,700	41′-4½″	31′	8′-7½″	63″	Double	"	4
9-B	15		44	Cross	48,000	40′-9″	31′	8′-9½″	59″	Double	"	4
10-B		4	42	Long	49,000	41′-4½″	31′	8′-7½″	63″	Double	"	4
11-B		19	42	Long	44,700	41′-3½″	31′	8′-9½″	62″	Double	"	4
12-B		50	42	Long	46,900	40′-11″	31′	8′-7½″	60″	Double	"	4
13-B	10		44	Cross	56,000	42′-9″	32′-6″	8′-6″	62′	Double	"	4
1-0	70		40	8-Bench	15,000	28′-2″		7′-8½″		Single	Hand	2
2-0	3		45	9-Bench	15,000	26′-4″		7′-6″		Single	Hand	2
3-0	10		50	10-Bench	27,500	37′-2″		7′-8¼″		Double	Hand	
											& Air	2
4-0	83		65	13-Bench	31,500	38′-2″		8′-4¼″		Double	"	2
5-0	128		65	13-Bench	35,000	40′-4″		8′-4¼″		Double	"	4
6-0	14		75	15-Bench	34,500	41′-10″		8′-4½″		Double	"	2
7-0	18		75	15-Bench	39,700	41′-10″		8′-4½″		Double	"	4
8-0	27		75	15-Bench	41,850	42′-0″		8′-5½″		Double	"	4

(a) Corner Doors.
(b) Baggage.

Report-City of Providence.
Authority-Rhode Island Co.

TABLE 11.

TYPICAL SCHEDULE SPEED—MAIN THOROUGHFARES.

Street.	Dist.	Time	M. H.	Location.
			Rapid	
Pawtucket av., East Prov.	7170	5	16.3	Water Tower—Vanity Fair
Smithfield av.	6550	5	14.9	City Line—Weeden st.
Cranston st.	6320	5	14.3	Nichols st.—Meshan't Pk. T.O.
North Main st.	6270	5	14.2	Jenkins st.—Car House
Eddy st. & New York av.	5380	5	12.2	Thurbers av.—N. Y. av. T. O.
Smith st.	5270	5	12.0	Elmhurst av.—State HomeT.O.
Branch av.	1895	2	10.8	Cushing av.—Terminus
Butler av.	4585	5	10.4	Banigan T.O.—Boulevard T.O.
Broad st. (Express)	5800	5	13.2	Trinity Sq.—Thurbers av.
			Medium	
Broadway	4125	5	9.4	Dean st.—Barton st.
Broad st.	3895	5	8.8	Winter st.—Public st.
North Main st.	3660	5	8.3	Smith st.—Branch av.
Waterman and Wayland	4140	5	9.4	Thayer st.—Banigan T. O.
Wickenden & Tockwotton	4050	5	9.2	South Main st.—Gano st.
			Slow.	
Westminster st.	2940	5	6.7	Mathewson st.—Winter st.
Cranston st.	2870	5	6.5	Winter st.—Parade st.
Elmwood av.	2860	5	6.5	Winter st.—Wesleyan av.
South Water & So. Main	2800	5	6.4	Market sq.—Wickenden st.
Eddy st.	2650	5	6.0	Public st.—Thurbers av.
Broad st.	2600	5	5.9	Public st.—Thurbers av.
			City Terminal.	
College, Prospect, West,	1600	5	3.6	Market Sq.—Brown st.
Dorrance & Weybosset	1800	5	4.1	City Hall—Market Sq.
Westminster & Dorrance	1550	5	3.5	Market Sq.—Exchange Place
Westminster st.	1400	5	3.2	Turks Head—Mathewson st.
Dorrance & Westminster	1660	5	3.8	Union Station—Mathewson st.

Report-City of Providence.

Authority-Rhode Island Co. (Five-minute Schedule Speed Sheets by Routes.)

TABLE 12.

DISTRIBUTION OF STOPPING POINTS.

SETTLED DISTRICTS OF PROVIDENCE.

	Mileage.	Number of Stops.	Stops per Mile.	Mean Interval in Feet.
Weybosset and Broad Streets, Dorrance St. to Trinity Sq.	0.91	23	25.3	209
Westminster Street, Turks Head to Hoyle Sq.	0.83	21	25.3	209
North Main Street, Market Sq. to Mill St.	0.44	11	25.0	211
So. Main and Wickenden Streets, Market Sq. to Traverse St.	0.70	15	21.5	246
Broad Street, Trinity Sq. to City Line	2.22	44	19.8	266
Elmwood Avenue, Trinity Sq. to City Line	2.64	50	19.0	279
Union Station to Chalkstone Avenue Terminus	2.43	47	19.3	273
Waterman Street, Prospect St. to Red Bridge	1.28	26	20.3	260
Entire City (25 Lines)†	104.835	2278	21.7	243

†These figures are not limited strictly to the City boundaries, nor do they include all lines; they represent conditions that are generally prevalent in well-settled districts.

Report-City of Providence.
Authority-Rhode Island Co.

TABLE 13.

LIMITED EXPRESS SUBURBAN SERVICE.
PROVIDENCE DISTRICT.

WASHINGTON PARK—Via Eddy to Edgewood and Pawtuxet. Inbound during the morning, outbound during the evening rush hour, first stop outbound and last stop inbound, New York Avenue.

BUTTONWOODS—Via Broad and private right of way. First stop and last stop Warwick Avenue Junction.

BUTTONWOODS—Via Elmwood and private right of way. First stop and last stop Park Avenue.

RIVERPOINT—Via Elmwood and Pontiac Avenue. First and last regular express stop Davis Turnout, South Auburn. Special City express stops inbound and outbound Carlisle Street and Roger Williams Park.

EAST GREENWICH—Via Elmwood and Apponaug Road. Outbound express, first stop Reservoir Avenue Junction, Columbus Park. Inbound, local, all stops except when City car follows unloaded, when express may omit regular stops.

ROCKY POINT—Via Broad and private right of way summer only, express stops same as Buttonwoods.

SOUTH ATTLEBORO—Via North Main and Pawtucket, first stop and last stop, State line.

WOONSOCKET—Via North Main and Charles, first stop and last stop, Hagan's Switch, just beyond City line.

ATTLEBORO, NORTH ATTLEBORO, FALL RIVER, WARREN & BRISTOL, TAUNTON AND DANIELSON LINES—All make local stops within City both inbound and outbound.

Explanatory Note: These expresses are designed to avoid imposing a local short haul load upon a full car of long haul riders beyond the City terminus and the points designated as first stop and last stop, respectively. Local riders are not permitted entrance or exit on the outbound trip unless they are willing to do so while the car is in motion. Thus, the Buttonwoods express loads with long distance riders all the way out Broad Street, and vice versa unloads inbound. Should any local passengers board the car along with the suburban passengers a transfer is refused by the announcement of the conductor "No transfers." A long distance rider, however, upon the payment of his last fare within the City limits may obtain a transfer.

TABLE 14.

SCHEDULE OF CAR HOUSES.

FOR LINES OPERATING IN PROVIDENCE.

Operating Car Houses.	*Capacity.*
Thurbers Ave., corner Broad St.,	190-40 ft. cars.
Elmwood Ave., corner Thackery St.,	112-40 " "
North Main St., at City Line,	116-40 " "
Academy Ave., south of Smith St.,	50-40 " "
Hartford Ave., west of Olneyville Sq.,	96-40 " "
Traverse St., corner Pike St.,	37-40 " "
Riverside, Pawtucket Ave., corner River Ave.,	51-40 " "
Arlington, Cranston St., west of Webster Ave.,	36-40 " "
Storage Car Houses.	
Chalkstone Ave., near Academy Ave.,	27-40 " "
Branch Ave., near City Line.	14-40 " "
Repair Shop.	
Cranston St., west of New Haven tracks.	

Report-City of Providence.
Authority—Rhode Island Company.

TABLE 15.

STUDY OF TERMINAL LOADING TIME

AND

AVERAGE LENGTH OF STOPS.

Switching Stations.

No. 1 —Electric Switch on Dorrance st., at Fulton st.—inbound.
No. 2 —On Washington st., at Dorrance st.—inbound.
No. 3 —On Dorrance st., at Weybosset st.—outbound.
No. 3A—On Weybosset st., at Dorrance st.—outbound.
No. 4 —On Westminster st., at Market Square—northbound.
No. 4A—On Westminster st., at Canal st.—southbound.
No. 5 —On North Main st., at Thomas st.—outbound.
No. 6 —On Westminster st., at Mathewson st.—outbound.
No. 7 —On Washington st., at Mathewson st.—outbound.
No. 8 —On Weybosset st., at Richmond st.—outbound.
No. 9 —On Washington st., at Jackson st.—outbound.
No. 10 —On North Main st., at Mill st.—outbound.

Total Number Stations,	10	
Total Number Stops.	123	
Total Time consumed,	1,134	seconds
Average Time Per stop	8.7	"
Average Time per passenger,		"
Average Number Passengers,		
Average Time for Switching,	6	"

Dorrance street north of Westminster street—Outbound—5:35 to 6:35 P. M.

Number cars passing,	90	
Number Stops made,	90	
Total Number Seconds,	1,211	
Total Passengers entering,	468	
Average Time per Passenger,	2.58	seconds
Average Time per stop,	13.45	"

Thirteen Trip Counts.

Number Stops,	537		
Time,	84 min.	45 sec	
Average Time per Stop,	9.4	seconds	
Minimum Individual Route average,	6.3	"	(Auburn)
Maximum Individual Route average,	14.2	"	(Manton)

Report-City of Providence.
Authority-Actual Observations.

TABLE 16.

PROPOSED REROUTING PLANS FOR LOADING DISTRICT.

Comparison of Car Flow by Various Plans in Cars per Hour.

Streets	Present Routing	Plan A.	Plan B.	Plan C.	Plan D.
Weybosset, Turks Head—Dorrance	108	75	77	77	77
" Dorrance, Mathewson E.	133	93	87	91	84
" Dorrance, Mathewson W.	47	71	61	61	61
" Mathewson—Chestnut E.	107	90	84	88	81
" Mathewson—Chestnut W.	88	66	56	56	79
Westminster, Turks Head—Dorrance	110	50	65	70	74
" Dorrance—Mathewson	111	63	70	70	77
" Mathewson W.	72	33	70	70	59
Washington, Mathewson—Dorrance E.	55	63	31	31	51
" Mathewson—Dorrance W.	48	64	70	70	58
Exchange Place E.	78	27	22	22	26
Exchange Place W.	64	66	44	51	47
Mathewson—Washington—Westminster	20	6	18	18	26
" Westminster—Weybosset	58	34	18	18	44
Dorrance, Weybosset—Westminster N.	66	52	41	45	32
" Weybosset—Westminster S.	76	54	44	44	38
" Westminster—Washington N.	73	59	53	62	49
" Westminster—Washington S.	84	74	55	55	58

Note: Plan A, suggested by Rhode Island Co.
" B, ideal plan based on street capacity.
" C, modified plan B, embodying concessions to shopping district.
" D, same as C, except South Providence cars returning via Weybosset street as in Plan A.

Report-City of Providence.
Authority-Part, Rhode Island Co.

TABLE 17.

ROUTE RECORD, CAR MILE AND SEAT MILE RATIOS

UNION DIVISION 1910.

ROUTE.	Passenger Earnings Per Car Mile—Cents. Actual Car.	Standard Car. (42-seats)	Total Passengers Per Car Mile. Actual Car.	Standard Car. (42-seats)	Per Seat Mile. Passenger Earnings Cents.	Total Passengers.
Edgewood & Pawtuxet	41	35	9.24	7.81	0.831	0.186
Washington Park	42	36	9.54	8.06	0.86	0.192
Thurbers via Broad	51	37	11.54	8.36	0.88	0.199
Buttonwoods via Broad	30	28	7.00	6.58	0.67	0.156
Friendship-Admiral	35	33	8.71	8.27	0.79	0.197
Prairie-Butler-Camp	35	48	8.56	11.70	1.14	0.278
Ocean-Hope-Pawtucket	37	51	8.97	12.28	1.22	0.292
Eddy to Edgewood	37	35	9.11	8.64	0.83	0.206
Elmwood-Reservoir-Chalkstone	41	39	9.75	9.26	0.93	0.220
Elmwood-Chalkstone-Roger Williams Park	47		11.75			
Broadway-Elmgrove (now Elmwood)	31		7.55			
Auburn-Camp	36	34	8.25	7.84	0.81	0.186
Brown-Mathewson	New Route					
Buttonwoods via Elmwood	32	31	7.45	7.12	0.74	0.169
East Greenwich	35	29	7.89	6.50	0.69	0.154
Riverpoint	31	28	6.66	6.12	0.67	0.146
Oaklawn	26	25	5.59	5.30	0.60	0.126
Cranston Print Works	40	38	9.61	9.12	0.90	0.217
Arlington	42	41	10.20	9.90	0.98	0.236
Union avenue	39	38	9.32	9.09	0.90	0.216
Dexter-Douglas	36	47	8.74	11.50	1.12	0.274
Dyer Av.—Swan Point	29	40	7.11	9.73	0.95	0.231
Olneyville-Plainfield Brook	40	38	10.08	9.55	0.90	0.227
Olneyville-Plainfield Governor	39	37	9.58	9.09	0.88	0.216
Hughesdale	32	30	7.52	7.23	0.71	0.172
Thornton	39	37	9.08	8.61	0.88	0.205
Hartford-Charles	36-21	34-20	9.03-5.53	8.60-5.27	0.81-0.48	0.205-0.125
Danielson Connection	38	36	8.98	8.57	0.86	0.204
Manton avenue	26	25	6.23	5.91	0.60	0.141
Centerdale via Manton	32	30	7.20	6.83	0.71	0.163
Promenade	28	33	7.53	8.88	0.79	0.211
Broadway-Rumford	29	40	6.78	9.28	0.95	0.221
Broadway-Phillipsdale	28	38	6.59	8.96	0.90	0.213
Broadway-Turks Head	28	32	6.37	7.35	0.79	0.175
Academy-Taunton	39	39	9.78	9.72	0.93	0.231
Centerdale-Esmond via Smith	28	27	6.22	5.90	0.64	0.140
Pawtucket via Main and Garden	37	32	8.94	7.66	0.76	0.182
Pawtucket via East	33	24	7.90	5.72	0.57	0.136
Branch avenue	27	26	6.62	6.28	0.62	0.149
Smithfield avenue	20	19	4.47	4.25	0.45	0.107
Woonsocket Connection	38	36	8.24	7.86	0.86	0.187
South Attleboro Connection	22	16	5.4	3.64	0.38	0.087
North Attleboro Connection	39	28	9.07	6.43	0.67	0.153
Attleboro Connection	42	30	9.91	7.03	0.71	0.167
Taunton Connection	49	43	10.40	9.04	1.02	0.215
Fall River Connection	29	28	6.61	6.33	0.67	0.151
Riverside	32	29	8.20	7.53	0.69	0.179

Report-City of Providence.
Authority-Rhode Island Co.

TABLE 18—1. SUMMARY PASSENGER COUNTS BY TRIPS.

TRIP ROUTE	†Eddy Express	Norwood via Broad	Thurbers via Broad	Edgewood via Broad	Pawtucket via Main	Pawtucket via Gardner	Pawtucket via East av.	Elmwood Elmgrove	Elmwood Reservoir Chalkstone	Auburn Eden P. Camp	Hartford Charles
Observations											
1. Date	1911 April 17	1911 April 17	1911 April 17	1911 April 17	1911 April 18	1911 April 18	1911 April 19	1911 April 19	1911 April 19	1911 April 19	1911 April 20
2. Car Numbers	1090	1087	1075	1069	1049	1043	1047	64	1309	843	805
3. Duration (Start	6:04	6:06	6:03:35	6:09	6:03	6:18	6.10	6:14:30	5:58:00	6:09:45	6:08:30
4. (End	6:32:20	6:33:50	6:20:20	6:47:45	6:31:7	6:55	6:42:15	6:37:30	6:20:30	6:47:29	6:42:00
5. Off Time, Leaving	2m 0s L	0:	25s F	1:00 F	2m 0s F	3m 0s L	0.	0m 30s F	3:00 L	1:45 L	1m 30s F
6. Off Time, Arriving	1m 50s L	2m 10s F	2m 40s F	2:45 L	4m 53s F	9m 0s L	1m 15s L	0m 30s L	1:30 L	2:29 L	4m 00s L
7. Distance in Miles	4.33	3.92	2.28	5.00	4.41	4.50	4.53	2.59	2.80	5.11	3.37
8. Number of Stops	25	36	30	52	43	49	40	31	33	36	38
9. Passengers On	83	34	53	87	49	91	47	44	80	49	64
10. Passengers Off	83	34	53	87	49	91	47	44	80	49	64
11. Cash Fares	78	32	47	74	45		40	27	55	47	39
12. Transfers	5	2	6	9	4		7	5	7	2	10
13. Tickets									1		1
14. Free Rides											
15. Total Fares	83	34	53	86	49		47	32	52	49	50
16. Seat Capacity	42	42	42	42	42	42	42	26	34	34	34
17. Total Time of Stops	4m 18s	2m 45s	3m 24s	6m 11s	6m 54s	7m 11s	4m 57s	3m 28s	4m 21s	4m 20s	5m 35s
18. Weather Conditions	Good	Good	Good	Good	Good	Good	Good	Cloudy	Good	Good	Good
Results.											
19. Maximum Load	80	33	53	67	(a)42	87	42	36	59	48	51
20. % Maximum Load to Total Fares	96.4%	97.1%	100%	77%	85.7%	95.6%	89.4%	81.9%	113.6%	98%'	102%
21. % Maximum Load to Seating Capacity	197.6%	78.5%	126%	159.6%	(a)100%	207%	100%	138.4%	173.4%	141.1%	150%
22. Average Haul—Miles	2.95	2.11	1.63	2.28	2.71	2.47	2.44	1.19	1.47	3.93	1.68
23. Schedule Speed—Miles per Hour	9.23	8.11	7.20	9.69	8.31	8.73	8.77	7.06	7.00	8.31	7.28
24. Av. Speed—Actual	9.18	8.76	8.17	7.90	9.41	7.29	8.47	6.78	7.46	8.14	6.04
25. Average Speed less Stops	10.82	9.15	10.26	9.51	10.44	9.06	9.96	7.96	9.25	9.39	7.25
26. Average Speed outside Congested Districts	10.08	9.52	10.57	8.88	10.91	7.79	10.34	10.18	9.38	9.52	7.18
27. Stops per Mile—Avg.	5.78	6.64	9.15	9.61	9.76	10.89	8.84	11.98	11.79	7.05	11.29
28. Distance between Stops—Average ft.	913	806	577	549	541	484	597	440	447	748	467
29. Average length stops Seconds	10.3s	4.6s	6.8s	7.1s	5.8s	8.8s	7.4s	6.7s	7.9s	7.2s	8.8s
30. % Time of Stops to Elapsed Time	15.2%	9.7%	40.3%	16.26%	20.4%	19.44%	15.56%	15.1%	19.3%	11.5%	16.7%

Note:—†Underlined routes indicate what part of through route observed.
(a) Attleboro car ahead 4m. late took much of this car's load.

Report—City of Providence.
Authority—Observations.

TABLE 18—2.

SUMMARY PASSENGER COUNTS BY TRIPS.

TRIP ROUTE	Manton av.	Plainfield — Brook-Governor	Arlington	Cranston Print Works	Oaklawn	Union av.	Regular Elmwood — Chalkstone	Tripper Elmwood Chalkstone	Academy Taunton	Academy Taunton
Observations										
1. Date	1911 April 20	1911 April 20	1911 April 21	1911 April 21	1911 April 21	1911 April 21	1911 April 24	1911 April 24	1911 April 24	1911 April 24
2. Car Numbers	820	29	463	96	464	456	856	473	496	831
3. Duration (Start	5:49:00	6:04:09	6:11:12	6:13:20	6:05	6:01:50	6:08	6:07:53	6:08:26	6:08:30
4. (End	6:28:40	6:36:08	6:37	6:47:40	6:57	6:33:00	6:34:30	6:29:52	6:30:30	6:25:00
5. Off Time, Leaving	1m 00 F	0:51 F	6:12 L	3:20 L	5:00 L	4m 50sL	3m 00s L	2:53 L	0:34 L	3:30 L
6. Off Time, Arriving	1:20 F	1:08 L	10m L	7m 40s F	13m L	9m 00sL	7m 30s L	2:52 L	0:30 L	3:00 L
7. Distance in Miles	5.19	3.22	2.42	3.85	7.13	3.28	3.51	2.52	2.62	2.47
8. Number of Stops	42	44	37	42	56	42	40	34	26	19
9. Passengers On	63	65	61	60	88	72	58	73	29	75
10. Passengers Off	63	65	61	60	88	72	58	73	29	75
11. Cash Fares	38	64		47	83	65	51	58	15	
12. Transfers	22	4		12	1	7	5	17	12	
13. Tickets	3	2		1	4		2			
14. Free Rides										
15. Total Fares	63	57		60	88	72	58	75	27	75
16. Seat Capacity	34	34	34	26	34	34	34	34	34	34
17. Total Time of Stops	(a)6m 56s	4m 28s	5m 13s	5m 3s	(b)6m 17s	5m 18s	5m 31s	4m 22s	3m 02s	2m 55s
18. Weather Conditions	Cold	Fair	Fair	Fair	Fair	Good	Fine	Fine	Fine	Fine
Results.										
19. Maximum Load	57	60	57	49	79	70	56	68	(c)29	72
20. % Maximum Load to Total Fares	90.4%	105.2%	93.4%	81.7%	89.8%	97.2%	96.6%	93.2%	100%	96%
21. % Maximum Load to Seating Capacity	167.8%	191%	167.6%	188.5%	235.5%	205.8%	164.9%	200%	85.3%	211.7%
22. Average Haul—Miles	2.9	1.72	1.60	1.99	4.83	2.09	1.67	1.34	1.64	1.76
23. Schedule Speed Miles per Hour	7.99	6.44	6.59	7.69	9.72	7.28	9.57	6.87	7.48	8.73
24. Av. Speed—Actual	(a)7.86	6.04	5.63	6.73	8.23	6.32	7.95	6.88	7.12	8.99
25. Average Speed less Stops	9.53	7.03	7.06	7.89	11.71	7.32	10.02	8.59	8.26	10.91
26. Average Speed outside Congested Districts	7.89	6.90	6.98	7.63	8.69	7.57	9.76	8.00	7.59	
27. Stops per Mile—Avg.	8.09	13.68	15.29	10.91	7.86	12.80	11.40	13.50	9.55	7.69
28. Distance between Stops Average ft.	652	386	345	483	672	412	462	391	552	685
29. Average length Stops Seconds	(a)9.9s	6.1s	8.5s	7.2s	6.7s	7.6s	8.3s	7.7s	7.0s	9.2s
30. % Time of Stops to Elapsed Time	(a)17.5%	14.0%	2.02%	14.7%	12.1%	17.0%	21.2%	1.99%	10.8%	17.7%

(a). 2m. 41s. wait at Olneyville Square.
(b). Excluding delay of 9m. 10s. at Print Works Turnout.
(c). Light load on account of car ahead.

TABLE 18—3.

SUMMARY PASSENGER COUNTS BY TRIPS.

TRIP ROUTE	Elmwood Chalkstone	Centerdale Greystone via Smith	Smith St. St. Home Tripper	Centerdale via Manton	Brook Plainfield	Governor Plainfield	Charles Hartford	Camp Auburn	Prairie Butler Camp	Prairie Butler Camp	Prairie Butler Camp
Observations											
1. Date	1911 April 25	1911 April 25	1911 April 25	1911 April 25	1911 April 26	1911 April 26	1911 April 26	1911 April 26	1911 April 27	1911 April 27	1911 April 27
2. Car Numbers	856	1311	496	814	28	24	805	842	192	203	48
3. Duration (Start	6:07:30	6:05:43	6:06:28	6:00	6:25:02	6:15:30	6:07:30	6:21:30	6:09:0	5:55:10	6:01;00
4. (End	6:36:30	6:53:40	6:37:50	6:51:45	6:39:20	6:29:45	6:23:00	6:37:50	6:35:20	6:14:36	6:24:30
5. Off Time, Leaving	2:30 L	0:43 L	1:28 L	0:	0:02 L	0:30 L	1:30 L	7:30 L	1:00 L	0:10 L	0:
6. Off Time, Arriving	9:30 L	13:40 L	12:50 L	6:45 L	0:40 F	0:15 F	0:	11:50 L	5:20 L	4:36 L	9:30 L
7. Distance in Miles	2.67	5.56	2.95	5.95	1.86	1.86	2.41	1.64	2.49	2.00	2.07
8. Number of Stops	25	44	38	61	21	20	19	19	33	23	34
9. Passengers On	89	85	69	76	30	60	46	61	58	38	55
10. Passengers Off	89	85	69	76	30	60	46	61	21	38	55
11. Cash Fares	64	77	46	65	46		34		56	24	22
12. Transfers	27	7	22	7	14		20		9	7	16
13. Tickets	1	1	1	4	3		2				
14. Free Rides											
15. Total Fares	92	85	69	76	63	60	56	40	65	31	38
16. Seat Capacity	34	34	34	34	34	34	34	34	*40	26	26
17. Total Time of Stops	(a)13m 20s	(b)15m 00s	(c)11m 08s	8m 22s	2m 54s	2m 11s	3m 46s	3m 46s	(d)6m 23s	(f)6m 32s	5m 45s
18. Weather Conditions	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fair	Good	Fine
Results.											
19. Maximum Load	84	78	61	55	28	57	44	(c)60	45	30	47
20. % Maximum Load to Total Fares	94.4	91.7	88.5	72.4	93.4	95.0	95.6	150		96.8	110.4
21. % Maximum Load to Seating Capacity	247%	229%	179.6%	161.7%	82.4%	167.8	129.4	176.8	112.5	115.3	161.6
22. Average Haul—Miles	1.33	3.84	1.61	3.00	.89	1.20	1.83	1.15	1.45	1.00	1.09
23. Schedule Speed—Miles per Hour	7.28	9.73	8.85	7.93	7.44	7.44	8.51	8.20	6.79	8.00	8.87
24. Av. Speed—Actual	(a)5.53	(b)6.96	(c)5.64	6.89	7.80	7.83	9.04	6.02	(d)5.67	(f)6.17	5.29
25. Average Speed less Stops	10.22	10.13	8.74	8.23	9.25	9.83	10.86	7.84	7.49	9.31	7.00
26. Average Speed outside Congested Districts		10.71	6.74	7.52		8.28	9.23	6.02	7.14	8.7	7.28
27. Stops per Mile—Avg.	9.74	7.91	12.89	10.25	11.29	10.74	7.89	11.58	13.24	11.50	16.42
28. Distance between Stops—Average ft.	542 ft.	667	409	514	467	491	668	456	398	458	321
29. Average length stops Seconds	(a)29.6s	(b)20.4s	(c)17.6s	8.7s	6.5s	8.7s	6.9s	11.9s	(d)11.6s	(f)17.0s	10.1s
30. % Time Stops to Elapsed Time	(a)46%	(b)31.2	(c)35.5	16.2	15.9%	20.4	14.1	23.1	(d)24.2	(f)33.6	24.5

* Open Car.

(a). 10m. 24s. waits at Smith street Turnout and Chalkstone junction for cars down.
(b). 4m. 35s. wait at Chalkstone for cars down.
(c). 5m. 03s. wait at Chalkstone for cars down.
(d). 1m. 35s. wait at Glenham Turnout.
(e). Light load according to conductor.
(f). 2m. 22s. wait at Market Square for grip car.

TABLE 18—4. SUMMARY PASSENGER COUNTS BY TRIPS.

TRIP ROUTE	Dexter Douglas	Dexter Douglas	Friendship Admiral	Friendship Admiral	Smithfield	Branch	Elmwood Elmgrove	Eddy Local	Dyer Swan Point	Dyer Swan Point
Observations										
1. Date	1911 April 28	1911 April 28	1911 April 28	1911 April 28	1911 May 1	1911 May 1	1911 May 1	1911 May 1	1911 May 2	1911 May 2
2. Car Numbers	96	287	488	451	1039	1034	65	46	7	3
3. Duration (Start	6:05:00	5:53:08	6:07	5:54:30	6:15:00	6:07:18	5:57:00	6:04:13	6:00:09	6:01:39
4. (End	6:31:37	6:07:12	6:32	6:21:00	6:48:15	6:38:18	6:21:00	6:33:45	6:36:42	6:37:10
5. Off Time, Leaving	0:	1:52 F	0:	0:30 F	0:	0:18 L	0:13 F	2:13 L	0:09 L	0:29 F
6. Off Time, Arriving	1:37 L	2:58 F	4:00 L	3:00 L	1:45 F	0:42F	1:00 L	0:15 F	1:42 L	7:10 L
7. Distance in Miles	2.84	1.87	1.97	2.72	4.97	4.35	2.51	4.21	4.13	3.38
8. Number of Stops	35	20	33	43	41	24	24	36	55	35
9. Passengers On	41	36	35	79	48	56	39	39	76	45
10. Passengers Off	41	36	35	79	49	56	39	39	76	45
11. Cash Fares	41	19	42	57	39	43	26	35	46	39
12. Transfers	3	14	3	22	9	13	4	3	11	6
13. Tickets								1	3	
14. Free Rides										
15. Total Fares	38	33	26	64	49	56	30	39	60	35
16. Seat Capacity	26	26	34	34	34	34	26	34	26	26
17. Total Time of Stops	2m 38s	2m 40s	5m 48s	5m 34s	6m 11s	3m 48s	3m 58s	(b)5m 37s	6m 30s	(a)10m 32s
18. Weather Conditions	Fine	Fine	Fine	Fine	Fair	Cloudy	Cloudy	Good	Cold	Cold
Results.										
19. Maximum Load	34	34	29	52	49	55	37	37	47	39
20. % Maximum Load to Total Fares	89.5	103	111.3	81.2	100.0	98.2	123.2	94.8	78.4	111.3
21. % Maximum Load to Seating Capacity	130.8	130.8	85.3	153.0	141.3	161.8	142.2	108.8	180.8	150.
22. Average Haul—Miles	1.69	1.10	.93	1.36	3.87	2.69	1.51	2.35	1.68	1.57
23. Schedule Speed—Miles per Hour	6.81	7.49	5.63	8.15	8.53	8.16	8.40	7.88	7.09	8.76
24. Av. Speed—Actual	6.40	7.98	4.73	6.16	8.98	8.42	6.28	(b)8.55	6.78	(a)5.71
25. Average Speed less Stops	7.10	9.84	6.16	7.80	11.01	9.60	7.53	10.57	8.24	8.12
26. Average Speed outside Congested Districts	8.09	7.98	6.6	6.77	8.98	8.42	8.29	9.08	7.74	7.72
27. Stops per Mile—Avg.	12.32	10.69	16.76	15.80	8.24	5.52	9.58	8.56	13.32	10.36
28. Distance between Stops—Average ft.	428 ft.	494	315	334	640	955	551	616	396	509
29. Average length Stops—Seconds	4.5s	8.0s	10.5s	7.8s	9.0s	9.5s	6.1s	(b)9.3s	7.1s	(a)18.1s
30. % Time of Stops to Elapsed Time	9.88%	19.0	23.2	21.0	18.6	12.25	16.5	(b)19.0	17.8	(a)29.7

(a). 5m. 15s. wait Market Square for grip car.
(b). 2m. 19s. wait Smith Street Turnout.

TABLE 18—5

SUMMARY PASSENGER COUNTS BY TRIPS.

TRIP ROUTE	Ocean Hope	Ocean Hope Pawtucket	Buttonwoods via Broad to Lakewood	Riverpoint to Pettaconset	E. Greenwich to Lincoln Pk.	Riverside	Brown Mathewson	Thornton Hughesdale via Broadway	Thornton via Westminster
Observations									
1. Date	1911 May 2	1911 May 2	1911 May 3	1911 May 3	1911 May 3	1911 May 4	1911 May 4	1911 May 4	1911 May 4
2. Car Numbers	573	295	671	1301	217	887	695	823	805
3. Duration (Start	6:05:00	6:18:20	5:45:15	5:43:30	6:20	6:08:08	6:09:30	5:49:40	6:04:30
4. (End	6:28:45	6:57:00	6:18:30	6:19:32	6:56:18	6:45:21	6:25:15	6:38:40	6:56:05
5. Off Time, Leaving	2:00 F	2:00 L	2:45 F	1:30 F	5:00 L	2:08 L	2:30 L	0:20 F	0:30 F
6. Off Time, Arriving	3:45	5:00 L	1:30 L	3:28 F	1:18 L	0:39 F	3:15 L	5:40	4:05 L
7. Distance in Miles	2.23	4.42	5.83	6.38	6.45	6.42	1.44	5.83	5.60
8. Number of Stops	26	45	33	32	26	41	15	70	54
9. Passengers On	29	72	62	66	56	72	19	103	87
10. Passengers Off	29	72	32	21	27	72	19	103	87
11. Cash Fares	27	47	49	23	(c)104	26	14	68	75
12. Transfers	5	8	10	21	9	16	5	30	11
13. Tickets			1	9	1	64		4	1
14. Free Rides									
15. Total Fares	25	55	62	53	114	72	19	102	87
16. Seat Capacity	*40	26	44	36	40	36	26	34	34
17. Total Time of Stops	4m 11s	(b)9m 07s	3m 29s	5m 19s	1m 52s	3m 38s	5m 24s	11m 51s	(a)7m 53s
18. Weather Conditions	Cold	Cold	Cold	Cold	Cold	Fair	Fair	Fair	Fair
Results.									
19. Maximum Load	25	52	58	50	51	70	19.	79.	66.
20. % Maximum Load to Total Fares	89.3	94.6	93.6	94.4	91.1	97.2	100.0	76.7	75.9
21. % Maximum Load to Seating Capacity	62.5	200.0	131.8	139.0	127.5	194.4	73.1	232.3	194.1
22. Average Haul—Miles	1.36	1.77				4.24	.94	2.42	2.38
23. Schedule Speed—Miles per Hour	7.09	8.04	12.07	10.08	9.68	9.65	5.76	8.31	7.15
24. Av. Speed—Actual	5.64	(b)6.86	10.38	10.61	10.66	10.34	4.69	7.14	(a)6.51
25. Average Speed less Stops	6.79	8.99	11.55	12.62	11.24	11.82	7.11	9.42	7.37
26. Average Speed outside Congested Districts	6.42	7.31	12.87	11.39	10.70	11.49	7.06	7.78	(a)6.99
27. Stops per Mile—Avg.	11.66	10.18	5.66	5.02	4.03	6.39	10.42	12.01	9.64
28. Distance between Stops—Average ft.	452	518	933	1050	1310	825	506	439	547
29. Average length stops Seconds	9.7	(b)12.2	6.3	10.0	4.3	5.3	21.6	10.1	(a)8.8
30. % Time Stops to Elapsed Time	17.6	(b)23.6	10.3	14.8	5.2	9.7	34.3	25.2	(a)15.3

* Open Car.
(a). 1m. 50s. wait at Plainfield street Turnout.
(b). 2m. 21s. wait at Cypress street Turnout.
(c). Two collections.

TABLE 18—6.

SUMMARY PASSENGER COUNTS BY TRIPS.

TRIP ROUTE	Promenade Phillipsdale	Promenade Phillipsdale	Broadway Rumford	Broadway Rumford
Observations.				
1. Date	May 5 1911	May 5 1911	May 5 1911	May 5 1911
2. Car Numbers	442	413	420	414
3. Duration (start	5:47:43	6:18:10	5:57	5:58:35
4. (end	6:04:43	6:58:10	6:19:25	6:25
5. Off Time, leaving	0:43 L	1:02 L	2:00 L	3:35 L
6. Off Time, arriving	2:17 L	9:10 L	4:15 L	0:
7. Distance in Miles	2.56	4.44	2.19	4.56
8. Number of Stops	26	32	29	20
9. Passengers On	53	49	83	45
10. Passengers Off	53	49	83	45
11. Cash Fares	55	39	24	45
12. Transfers	8	10	17	5
13. Tickets			1	
14. Free Rides				
15. Total Fares	20	20	42	45
16. Seat Capacity	26	26	26	26
17. Total Time Stops	2m 51s	(a) 14m 0s	7m 37s	2m 10s
18. Weather Conditions	Clear	Clear	Clear	Clear
Results.				
19. Maximum Load	38	47	55	44
20. % Max. Load to Total Fares	190.0	225.0	131.0	97.8
21. % Max. Load to Seating Capacity	146.1	180.8	211.6	169.2
22. Average Haul—Miles	1.53	2.43	.88	3.04
23. Schedule Speed—Miles per Hour	9.67	8.63	6.57	9.12
24. Average Speed—Actual	9.04	(a) 6.66	5.86	10.31
25. Average Speed—Less Stops	10.85	10.23	8.88	11.14
26 Average Speed Outside Congested District	9.82	6.78	7.28	10.31
27. Stops Per Mile—Avg.	10.17	7.21	13.23	4.39
28. Distance Between Stops—Avg.	519 ft.	732 ft.	398 ft.	1200 ft.
29. Average Length Stops—Seconds	6.6	(a) 26.2	15.8	6.5
30. % Time Stops to Elapsed Time	16.8	(a) 35.0	34.0	8.1

(a) 9m 12s waits at Red Bridge and Six Corners Turnouts.

TABLE 19.

RUN OFF OR DEAD MILEAGE.

Union Traction Division.

Route—From Winter Schedule	Total Dead Mileage. Revenue. Miles.	Revenue. Per cent. of Line.	Dead. Miles.	Dead. Per cent. of Line.	Total Mileage.	Total Per cent.
1-1 Edgewood & Pawtuxet	86.26	5.46			86.26	5.46
1-2 Washington Park (Broad)			24.82	11.90	24.82	11.90
1-8 Eddy St. (Edgewood)	48.07	17.58	6.61	6.94	54.68	24.52
1-9 Eddy St. (Thurbers Av.)			5.29		5.29	
BARN TOTAL	134.33		36.72		171.05	
2-1 Elmwood—Chalkstone—Res.			7.98	0.74	7.98	0.74
2-3 Auburn—Camp St.			41.45	4.10	41.45	4.10
BARN TOTAL			49.43		49.43	
4-1 Oaklawn	28.23	5.12			28.20	5.12
4-2 Cranston Print Works			6.72	1.75	6.72	1.75
4-4 Union Av.			34.53	8.90	34.53	8.90
4-5 Dexter St.—Douglas Av.			15.37	3.02	15.37	3.02
BARN TOTAL	28.23		56.62		84.85	
5-1 Dyer Av.—Swan Point	23.60	2.81	1.21	0.14	24.81	2.95
5-15 Olneyville—T. H.—Dyer Av.			1.01	1.17	1.01	1.17
5-2 Olneyville—Brook St.			0.61		0.61	
5-3 Olneyville—Governor St.			0.61		0.61	
5-4 Oly.—Plainfield—Brk.—Gov.	7.23	0.74	0.61	0.06	7.84	0.80
5-5 Hughesdale	26.60	6.02	1.01	0.29	27.61	6.31
5-6 Thornton	7.60	9.16	0.71	0.86	8.31	10.02
5-7 Hartford Av.	7.47	4.53			7.47	4.53
5-9 Manton Av.	25.61	4.67	1.21	0.22	26.83	4.89
5-10 Centerdale via Manton	35.55	6.26	1.21	0.21	36.76	6.47
5-11 Promenade St.			1.60	0.87	1.60	0.87
5-12, 13, 14 Broadway—Rumford—Phillipsdale—Turks Head			2.64	0.20	2.64	0.20
BARN TOTAL	133.66		12.43		146.09	
6-1 Academy Av.—Taunton Av.	1.64	0.16	19.48	1.92	21.12	2.08
6-2 Centerdale via Smith St.	61.43	8.35	26.15	3.55	87.58	11.90
BARN TOTAL	63.07		45.63		108.70	
7-1) Pawtucket—Main St.)	37.78)	6.50)	0.80)	0.09)	38.58)	6.59)
7-2) Pawtucket—Garden St.)	22.53)	)	)	)	22.53)	)
7-3 Pawtucket—East Av.	7.96	2.53			7.96	2.53
7-5 Branch Av.	43.50	8.78	12.85	2.60	56.35	11.58
7-6 Smithfield Av.	56.74	8.49	15.09	2.30	71.83	10.79
7-7 Woonsocket Connection	also large					
BARN TOTAL	168.51		28.74		197.25	
TOTAL ALL BARNS	527.80	2.04	229.57	0.89	757.37	2.93
TOTAL, incuding SUBURBANS					1,158.00	4.48

TOTAL Revenue Car Mileage for System per day—25,830 car miles.

Note.—Revenue dead mileage is that part of the total dead mileage over which occasional fares are taken to or from the car house.

Report-City of Providence.

Authority-Rhode Island Co.

		Runni
al Day.	Outbound	Inbc
nin.)	33 min.	35
)	28 "	30
")	19 "	21
"	51 "	51
"	39 "	39
20	34 "	34
30	37-52P.	38-5
min.	32 min.	26
	21 "	15
min.	40-42m.	40-
"	36 min.	37
"	49 "	49
	15 "	15
"	55 "	55
"	75 "	75
"	85 "	85
min.	44 min.	44
	30 "	30
"	22 "	22
min.	27 min.	27
"	40 "	40
"	55 "	55
	18-30D.	18-3
0 ")	35 min.	35
0 ")	35 "	35
0 ")	45 "	45
0 "	43 "	39
0 min.	45 min.	43
0 "	28 "	25
0 "	40 "	40
0 "	45 "	41
0 "	15 "	15
0 ")	50 "	50
0 ")	49 "	47
30 ")	20 "	20
20-10	21-38TM	21-3
20 "	31 "	29
20 "	31 "	29
30 "	31 "	29
60 "	27 "	23
20 "	32 "	26
30 "	43 "	43
30 "	58 "	55
60 "	25 "	25
30 ")	31 "	29
30 ")	31 "	29
60 min.	25 min.	25
30 "	25 "	25
20 ")	40 "	40
60 ")	90 "	90

ban Lines.
nditions 5:30 to 6:30 P. M

TABLE 20

TABLE 20

WINTER SCHEDULE, RUSH HOUR, MIDDAY AND NORMAL.   UNION DIVISION (1910-1911).

Route No.	Designation of Route by Car House Divisions.	Headway Min. Rush Hour.	Headway Min. Midday.	Headway Min. Normal Day.	Running Time—Min. Outbound	Running Time—Min. Inbound.	Running Time—Min. Layover.	Mileage Outbound	Mileage Inbound.	Cars Scheduled Rush Hour.	Cars Scheduled Midday.	Cars Scheduled Normal Day	Seating Capacity 26	28	34	[illegible]	40	42	44	Seats Scheduled. Rush Hour	Seats Scheduled. Midday.	Seats Scheduled. Normal Day.	Seat Flow-Rush. Trips per Hour.	Seat Flow-Rush. Seats per Hour.	Route No
1-1	Edgewood & Pawtuxet	(10 min.	10 min.	10 min)	33 min.	35 min.	2 min.	4.985	4.985	17	7	7						17		714	294	294	(16	(714	1-1
1-2	Washington Park	(10 "	10 "	)	28 "	30 "	2 "	3.88	3.88	9	6				8			1		314	204		(9	(314	1-2
1-3	Thurbers Ave. via Broad St.	(10 "	10 "	10 ")	19 "	21 "		2 225	2.225	5	4	5			5					170	136	170	(6	(204	1-3
1-4*	Buttonwoods via Broad St.	30 "	30 "	30 "	51 "	51 "	18 "	12.985	12.985	9	3	3				1			8	388	132	132	6	256	1-4
1 5	Friendship-Admiral St.	10 "	20 "	20 "	39 "	39 "	2 "	4.83	4 83	11	4	4			11					374	134	136	6-F 9A	204-306	1-5
1-6	Prairie-Butler-Camp St.	10-20	10 20	10-20	34 "	34 "	2 "	4 18	4 18	12	7	7	12							312	182	182	8-P 6-B-C	208-156	1-6
1-7	Ocean-Hope St.-Pawtucket	15-30	15-30	15-30	37-52P.	38-53P.		3 705	3.705	11	6	6	11							[illegible]	156	156	6-O-8 H	156-208	1 7
1-8	(Eddy St. to Edgewood	(10 min.	10 min.	10 min.	32 min.	26 min.	2 "	4.47	4 37	10	6	6			10					(340	204	204	(10	(340	1-8
1-9	(Eddy St. to Thurbers Av.	(10 min.			21 "	15 "	4 "	1 94	1.84	3			1		2					(94			(4	(128	1-9
2-1	Elmwood-Reservoir-Chalkstone	10 min.	10 min.	10 min.	40-42m.	40-42	10-6	5 31	5.31	15	9	9	1		14					502	306	306	(10-C 7-E	(340-230	2-1
2-2	Elmwood-Elmgrove Av.	20 "	20 "	20 "	36 min.	37 min.	7 min.	3.61	6.31	5	4	4	5							130	104	104	4-Elg. 3-Elm	(104-78	2-2
2-3	Auburn-Camp St.	10-20	20 "	20 "	49 "	49 "	2 "	6 775	6.775	16	6	5	2		14					528	204	170	4-C 12-A	136-392	2-3
2 4	Brown-Mathewson St.	20 min.	20 "		15 "	15 "	10 "	1.36	1.29	2	2		2							52	52		3	78	2-4
2-5*	Buttonwoods via Elmwood Av.	60 "	60 "	60 "	55 "	55 "	10 "	13.51	13.51	3	1	1							3	132	44	44	3	132	2-5*
2-6*	East Greenwich	30 "	30 "	30 "	75 "	75 "		13 44	13 44	7	5	5						7		294	210	210	3	126	2-6*
3*	Providence & Riverpoint	30 "	30 "	60 "	85 "	85 "	10 "	16.19	16.19	7	4	4				7				252	144	144	3	108	3*
4-1	Oaklawn	30 min.	30 min.	30 min.	44 min.	44 min.	2 min.	7 19	7.19	3	3	3			3					(102	102	102	2	68	4-1
4-2	Cranston Print Works	10 min.)	10 "		30 "	30 "		3.83	3 83	7	4				7					(238	136		7	238	4-2
4-3	Arlington	10 ")	10 "	10 "	22 "	22 "	6 "	2.485	2.485	15	5	4	9		4					(370	170	136	14	404	4-3
4-4	Union Av.	20 min.	20 "	20 min.	27 min.	27 min.	6 "	3 31	3 31	8	3	3	5		3					232	102	102	8	232	4-4
4-5	Dexter St.-Douglas Av.	20 "	20 "	20 "	40 "	40 "		4 72	4.72	5	4	4	1	4						138	112	112	4-D 3-D av.		4-5
5-1	Dyer Av.-Swan Point	20 "	20 "	20 "	55 "	55 "	10 "	7 23	7 23	7	6	6	7							182	156	156	3-S. P. 4-D	78-104	5-1
5-15	Olneyville, T. H. & Dyer Av.	20 "	20 "		18-30D.	18-30D.	4-0 "	2 00	2.00	4	2		2		2					124	72		4	128	5-15
5-2	(Olneyville-Brook St.	20 min.)	20 ")	20 ")	35 min.	35 min.		3.655	3.655														(3-B	(102	5-2
5-3	(" -Governor St.	20 ")	20 ")	20 ")	35 "	35 "		4.00	4.00	10	8	8	1		9					332	272	272	(3-G	(102	5-3
5-4	(Plainfield-Governor-Brook	30 ")	30 ")	30 ")	45 "	45 "		4 86	4 86														(8 Ol & Pl	(264	5-4
5-5	(Hughesdale	30 ")	30 ")	30 "	43 "	39 "	8 "	5 61	5.80	5	3	3			5					(170	102	102	(3	(102	5-5
5-6	(Thornton	30 ")						4.39	4.39	5					5					(180			(5	(170	5-6
5-7	Hartford Av.-Charles St.	30 min.	30 min.	30 min.	45 min	43 min.	2 "	5 93	5.68	5	3	3	2		3					160	108	108	4-H 2-C	120-68	5-7
5-8*	Danielson Connection	60 "	60 "	60 "	28 "	25 "	7 "	3.345	3.345	1	1	1							1	44	44	44	1	44	5-8*
5-9	Manton Av.	20 "	20 "	20 "	40 "	40 "		4 845	4.815	8	4	4	2		6					268	144	144	6	204	5-9
5-10	Centerdale via Manton Av.	30 "	30 "	30 "	45 "	41 "	4 "	6.07	5 95	7	3	3			7					252	108	108	3	102	5-10
5-11	Promenade Street	15 "	30 "	30 "	15 "	15 "		2 315	2 315	4	1	1	3		1					112	34	34	5	146	5-11
5-12	(Broadway-Rumford	30 ")	30 ")	30 ")	50 "	50 "		6.71	6.65														(8-B	(208	5-12
5-13	(Broadway-Phillipsdale	30 ")	30 ")	30 ")	49 "	47 "	4 "	6.25	6.19	18	8	8	16		2					488	208	208	(5-R	(130	5-13
5-14	Broadway-Turks Head	30 ")	30 ")																				(4-P	(104	5-14
6-1	Academy-Taunton Av.	10-5 m.	20-10	30 ")	20 "	20 "		1 95	1.95	15	7	7	2		13					520	252	252	14-A 6-T	460-204	6-1
6-2	Centerdale & Esmond via Smith Street	20 min.	20 min.	20-10	21-38TM	21-38	8-4	2 63	2 63	7	4	4			7					238	144	144	7	238	6-2
7-1	Pawtucket, Main St.	10 min.)	10 "	20 "	31 "	29 "		4.37	4 23	10	6	3			3			7		(396	238	132	10	396	7-1
7-2	Pawtucket, Garden St.	20 ")	20 "	20 "	31 "	29 "		4 33	4.19	3	3	3			2			1		(110	110	110	3	110	7-2
7-3	Pawtucket, East Av	30 "	30 "	30 "	31 "	29 "		4 45	4 31	2	2	2			2					68	68	68	2	68	7-3
7-4	Pawtucket, Lonsdale Av.	60 "	60 "	60 "	27 "	23 "		3.82	3 62	1	1	1	1							26	26	26	1	26	7-4
7-5	Branch Av.	20 "	20 "	20 "	32 "	26 "	2 "	4.21	4 07	6	3	3			6					216	108	108	6	204	7-5
7-6	Smithfield Av.	30 "	30 "	30 "	43 "	43 "	4 "	7.72	7 72	5	3	3	1		3			1		170	108	108	4	136	7-6
7-7*	Woonsocket Connection	30 "	30 "	30 "	58 "	55 "	7 "	14 78	14 64	3	2	2							3	132	88	88	3	132	7-7*
7-8*	South Attleboro Connection	60 "	60 "	60 "	25 "	25 "		4 19	4 05	1	1	1						1		44	44	44	1	44	7-8*
7-9*	North Attleboro, Pawt. Av.	) 30 ")	30 ")	30 ")	31 "	29 "		4 19	4 05	3	2	2						3		132	88	88	3	126	7-9*
7-10*	Attleboro Connection Pawt. Av.	) 30 ")	30 ")	30 ")	31 "	29 "		4.19	4 05	3	2	2						3		132	88	88	3	126	7-10*
8-1*	Taunton Connection	60 min.	60 min.	60 min.	25 min.	25 min.	10 min.	3 555	3 555	2	1	1					2			80	40	40	2	80	8-1*
8-2*	Fall River Connection	30 "	30 "	30 "	25 "	25 "	10 "	4.10	4 10	3	2	2	1				2			106	80	80	3	106	8-2*
9-1	Riverside	10 min.)	20 ")	20 ")	40 "	40 "		7 295	7 295	15	6	6			15					540	216	216	(	(	9-1
9-2*	Barrington, Warren & Bristol	60 ")	60 ")	60 ")	90 "	90 "	20 "	17.66	17 66														(12	(408	9-2*
										331	177	159	87	4	172	8	4	41	15	11184	5732	5472			

Total 331

* Suburban Lines.

Note: Rush hour schedule based upon maximum service conditions 5:30 to 6:30 P. M.
Report—City of Providence.
Authority—Rhode Island Co.

TABLE 21.

APPROXIMATE DESTINATION OF MILL OPERATIVES REPORTED BY COMPANIES FROM CANVASS.

DESTINATION STREET OR DISTRICT.	General Fire Ext. Company.	Brown & Sharpe.	Rumford Chemical Works.	American Electrical Works.	General Fire Ext. Company.	Gorham Manfg. Company.
Location of Works.	Promenade.	South Main.	Phillipsdale.	Aborn.	South Auburn.	Elmwood.
No. of men canvassed	2912	238	505	(a)269	(b)398	394
Reported as walking	1500	75		113	84	
Reported as riding	1412	163	505	135	259	
Cranston Street	23			1		
Washington Park	63	6		11		
South Providence	105	11	75	15	6	20
Elmwood	60	9		4	6	93
Auburn & Eden Park	40			1		65
Arlington	35			5		
Cranston	15	12		1	38	15
Smith Hill	7	4			4)	
Mount Pleasant	43			11	28)	
East Side	70	30	55		8)	65
North End—Branch Av.—					)	
Wanskuck	40			4	4)	
Eagle Park—Admiral St.—					)	
North Side	56			3	)	
Eagle Park—Admiral St.—						
No. Providence (Smith st.)	60)	22		1	)	11
No. Providence (Manton Av.)	15)			1	)	
Smithfield Av.	33					
Saylesville, etc.	35				1	
Buttonwoods line beyond Pawtxt.	28	3		3	4	
Pawtucket	110		110	7	3	10
Johnston	9			5		
Edgewood & Pawtuxet	37			2	6	18
E.Greenwich line beyond Auburn	25			8	8	54
Riverpoint Sub.	4			5	10	
Manton	6			2		
Olneyville	295	13			17	30
E. Prov. & Massachusetts	88	57	(c)25	3	)	13
Riverside, etc.	95		55	10	1)	
North Main street	3			1		
Thornton	3					
Oaklawn, etc.	4			1	9	
Westminster street	5		75			
Broadway		2	70	8		
Federal Hill					34	
Market Square			(d)40			
City					78	
Walking distance		75		113	84	

(a) 21 use steam road.
(b) 55 " " "
(c) To Ingrahams Corners.
(d) Probable end of ride.

Report—City of Providence
Authority—Manufacturers.

NOTE ON "NEAR SIDE" CAR.

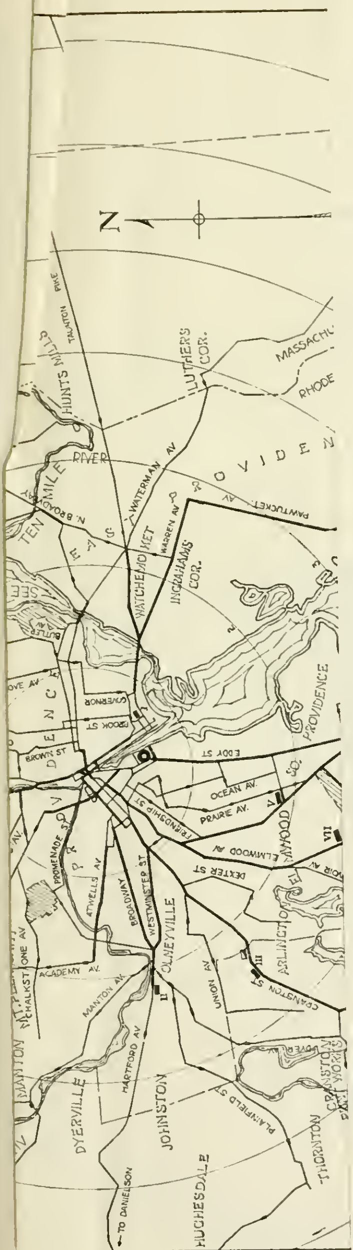
* Since the delivery of this report and while it was being printed, another modification of the Prepayment Car known as the "Near-Side" car, has been placed upon the market and will be first used in Buffalo. While essentially equivalent to the other prepayment types, it differs from them in the use of a single platform at the front end, where both motorman and conductor are stationed, thus being suited only to single-ended operation. As its name indicates, this type of car is especially adapted to stopping on the near side of the street opposite crosswalks. In general, the recommendations of the report are equally applicable to this as to preceding types discussed.

See Page 109.

INDEX TO TABLES AND PLATES.

DATA OF RECORD.

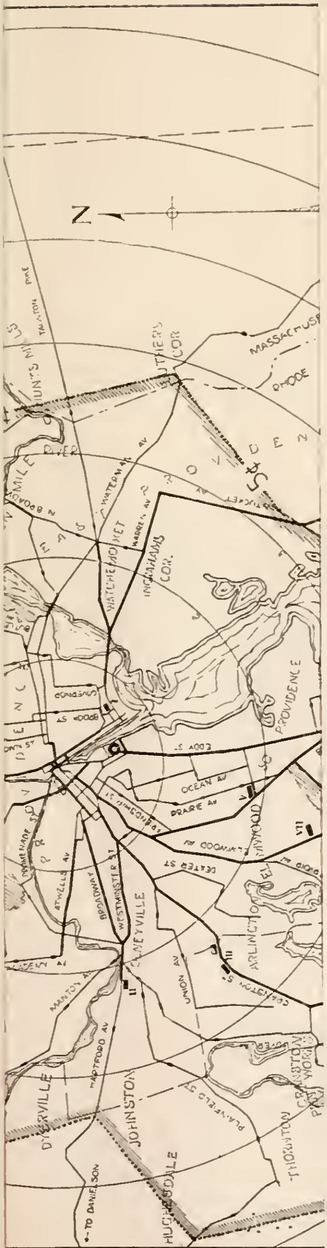
Drawings and Maps in Supplementary Folio. *Plates.*


N
TAUNTON PIKE
HUNTS MILLS
LUTHERS COR.
MASSACHU
RHODE
TEN MILE RIVER
P R O V I D E N
WATERMAN AV
N. BROADWAY
WARREN AV
PAWTUCKET AV
E A S T
WATCHEMOKET
INGRAHAMS COR.
SEE
BUTLER AV
GOVERNOR
BROOK ST
BROWN ST
EDDY ST
PROVIDENCE
OCEAN AV.
PRAIRIE AV.
FRIENDSHIP ST
ELMWOOD AV
DEXTER ST
PROMENADE
ATWELLS AV
BROADWAY
WESTMINSTER ST.
OLNEYVILLE
ARLINGTON
UNION AV
CRANSTON ST
ACADEMY AV.
CHALKSTONE AV
MANTON AV.
MANTON
HARTFORD AV
DYERVILLE
JOHNSTON
PLAINFIELD ST
CRANSTON PRINT WORKS
THORNTON
TO DANIELSON
HUGHESDALE

I

PLATE I—TRACKAGE MAP—PROVIDENCE DISTRICT.

Comprising all street and interurban trackage within the Providence Traction District not only of the Rhode Island Co., but also of the Fall River, Taunton, Attleboro, Danielson and Woonsocket connections. All but the last named are foreign lines Double track is indicated by heavy lines, similarly turnouts; buildings are coded. The small proportion of double track, for a city so evenly settled as Providence is noticeable.


PROVIDENCE
OLNEYVILLE
JOHNSTON
ARLINGTON
THORNTON
HUGHESDALE
DYERVILLE
TO DANIELSON
INGRAHAMS COR.
WESTMINSTER ST
BROADWAY
ATWELLS AV
PROMENADE ST
HARTFORD AV
MANTON AV
UNION AV
DEXTER ST
PRAIRIE AV
OCEAN AV
EDDY ST
PLAINFIELD ST
WARREN AV
RIVER
RHODE

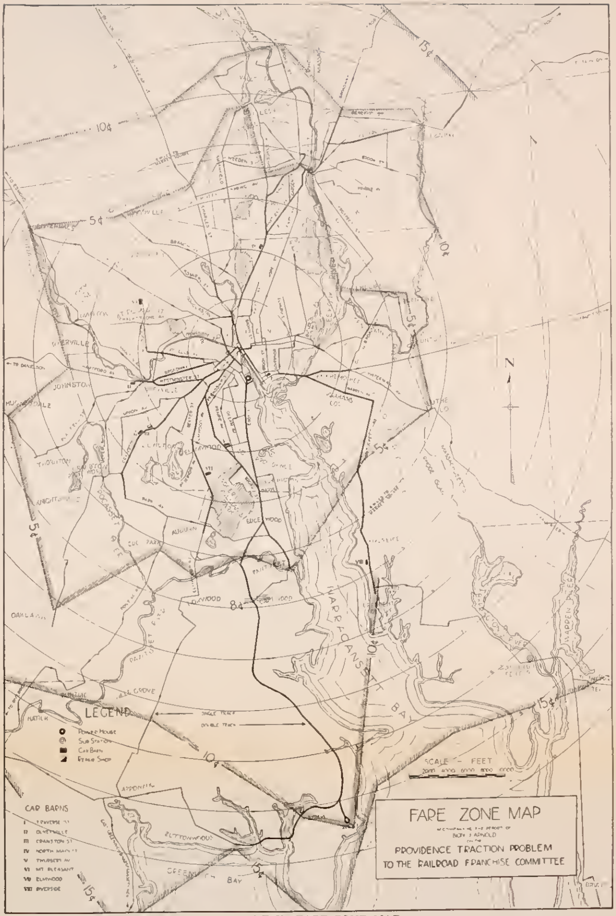


PLATE II—FARE ZONE MAP.

Showing, by shaded contours, the limits of the present 5 cent fare zone, also 10 cent and 15 cent zones on rides from the center of Providence. Note how irregularly the 5 cent zone has been extended beyond the city limit, e. g.—to Oaklawn and Saylesville as compared with Phillipsdale and the long ride to Rocky Point for 10 cents, as compared with 8 cents to Lakewood.

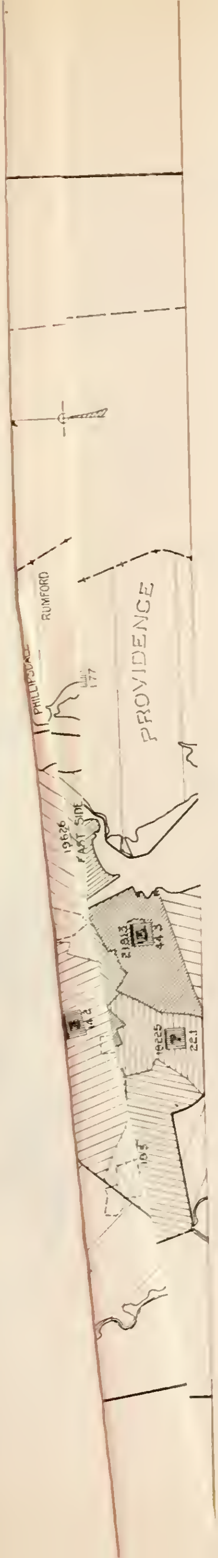
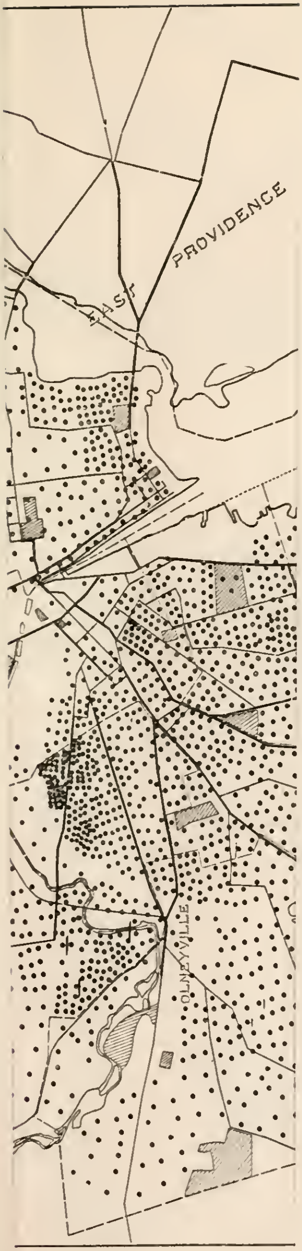

RUMFORD
PROVIDENCE
EAST SIDE

PLATE III—POPULATION, GROWTH AND DENSITY.

Indicating by wards or other minor civil divisions, 1st—the population in figures above the blocks and by the proportional area of the blocks; 2nd—the growth from 1905 to 1910 by solid black portions of the blocks; 3rd—density in persons per acre in decimals and by shading; close spacing of lines representing dense areas and vice versa. Densities less than one person per acre are not shaded. Note comparative densities of ward 9 (Federal Hill) and ward 2 (East Side). Densities in other cities range as high as 1000 persons per acre (New York). The growth appears quite uniform throughout the city.


EAST
PROVIDENCE
OLNEYVILLE

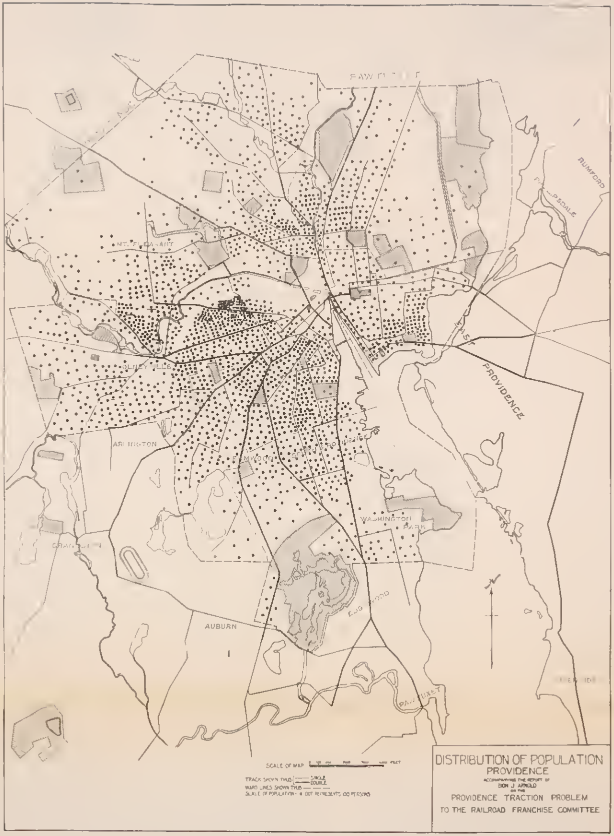


PLATE IV—DISTRIBUTION OF POPULATION.

Showing by means of dots (each representing 100 persons) the actual distribution of population throughout Providence, based upon the 129 enumerating districts of the 1910 census. It accurately locates sleeping population. Note the uniform distribution with the exception of outer Smith street and the upper East Side. Only one center of congestion appears—Federal Hill. The absence of double track in many sections of considerable density is noticeable, e. g.—Manton and Branch avenues, Smith and Plainfield streets.

TO TAUNTON
N
TAUNTON PIKE
HUNTS MILLS
LUTHERS COR.
TEN MILE
WATERMAN AV
WATCHEMOKET
INGRAHAMS COR.
SEEKONK
GOVERNOR
BROOK ST
BROWN ST
EDDY ST
OCEAN AV
PRAIRIE AV
DEXTER ST
PROMENADE ST
ATWELLS AV
BROADWAY
WESTMINSTER ST
UNION AV
MT. PLEASANT
CHALKSTONE AV
MANTON
DYERVILLE
HARTFORD AV
JOHNSTON
PLAINFIELD ST
TO DANIELSON
HUGHESDALE

V

PLATE V LIMITS OF THE UNION RAILROAD DIVISION.

Indicating by code the relative trackage within Providence and within the limits of the Union Division. These limits practically correspond to those of the present 5 cent zone. All computations and data used in the report, as from the Union Division, refer to the district shown here. It is evident from the map that traction studies, based upon the city limits only, would be quite incomplete.

PLAT

car loading at va
inbound; 2nd—hea
outbound trips of
ading. Note irreg
ered inbound, but n

VI

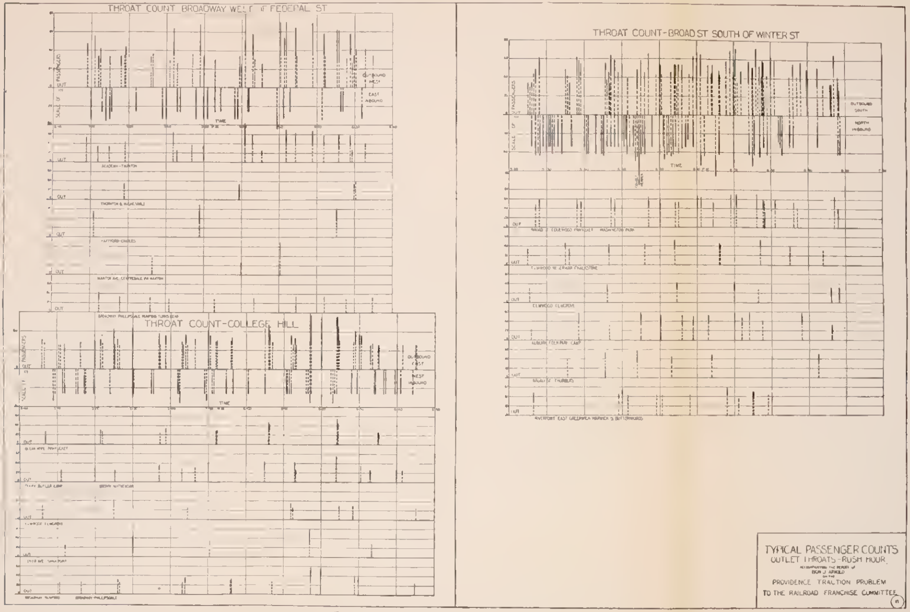
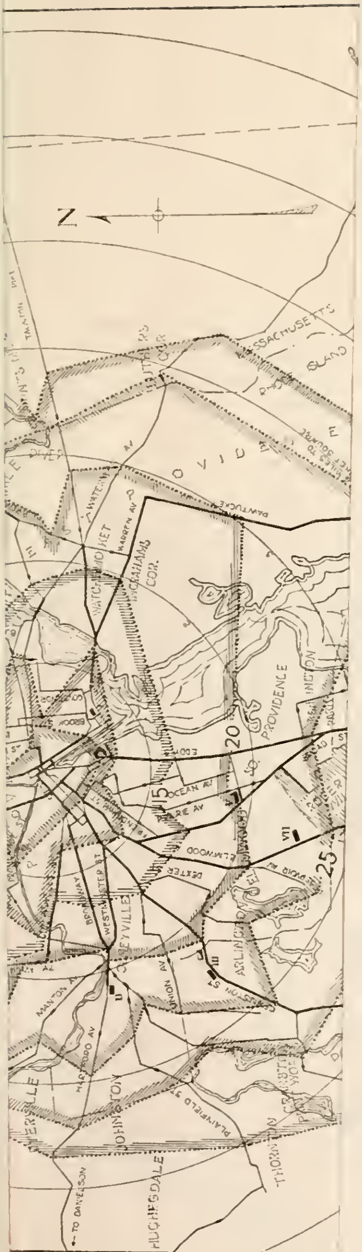


PLATE VI—TYPICAL THROAT COUNTS.

Graphical records of typical passenger car loading at various outlet throats from the down-town district during the evening rush hour. These show, 1st—number of cars passing, both outbound and inbound; 2nd—headway or spacing; 3rd—seating capacity; 4th—standing load. Dotted lines represent seated load, hollow lines empty seats. Below, are shown outbound trips of individual routes passing through the throat. Counting points were selected far enough from the loading district to indicate maximum car loading. Note irregular spacing of cars and heavy loading of delayed cars, e. g.—Academy Avenue 6:01, 6:03, 6:05 P. M. Occasionally heavy loads are encountered inbound, but mostly empty seats


N
MASSACHUSETTS
ISLAND
PAWTUCKET
WARREN AV
PROVIDENCE
OCEAN AV
ELMWOOD
DEXTER
BROADWAY
WESTMINSTER ST
MANTON AV
HARTFORD AV
UNION AV
ARLINGTON
JOHNSTON
PLAINFIELD ST
THORNTON
HUGHESDALE
TO DANIELSON
15
20
25

VII

PLATE VII— TIME ZONE MAP.

Indicating by means of shaded contours the distance that is run on various lines under the present winter schedule, within periods of 5, 10, 15 Minutes, etc., counting from the down town terminus. The 5 minute zone is necessarily irregular, owing to different starting points being taken on various lines. Divergence of these contour lines indicates faster running speed and vice versa. Note that Riverside is reached in 25 minutes and Pawtuxet in 35, both about 4¼ miles distant from the city

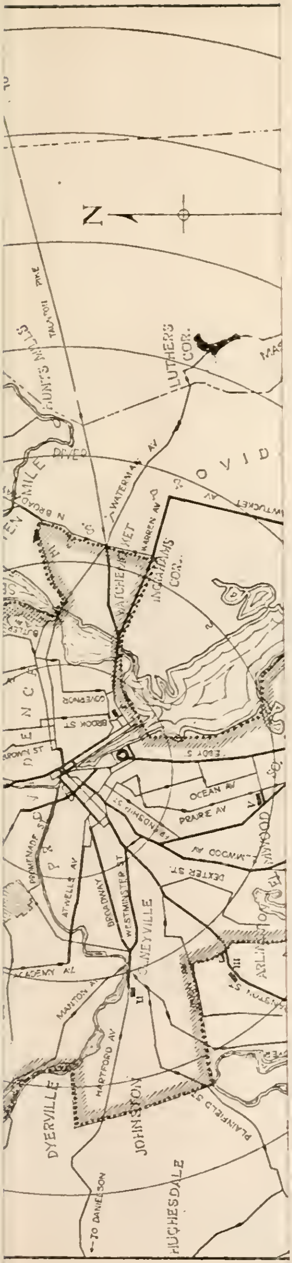

N
HUNTS MILLS
LUTHERS COR.
WATERMAN AV
INGRAHAMS COR.
WARREN AV
N BROAD ST
BROOK ST
EDDY ST
OCEAN AV
PRAIRIE AV
DEXTER ST
PROMENADE ST
ATWELLS AV
BROADWAY
WESTMINSTER ST
ACADEMY AV
MANTON AV
HARTFORD AV
DYERVILLE
JOHNSTON
HUGHESDALE
PLAINFIELD ST
TO DANIELSON
ARLINGTON
ELMWOOD

PLATE VIII—TRANSFER ZONE MAP.

Indicating the limits of the present transfer zone, i. e., the territory within which passengers can transfer to other points of the city for a single fare. Inbound passengers boarding the cars outside of these limits cannot obtain transfers through the center of the city for one fare and vice versa. Note that these limits correspond to the city limits with few exceptions, e. g.—East Providence and the Buttonwoods Express line on which the transfer zone is extended to Warwick Avenue Junction.

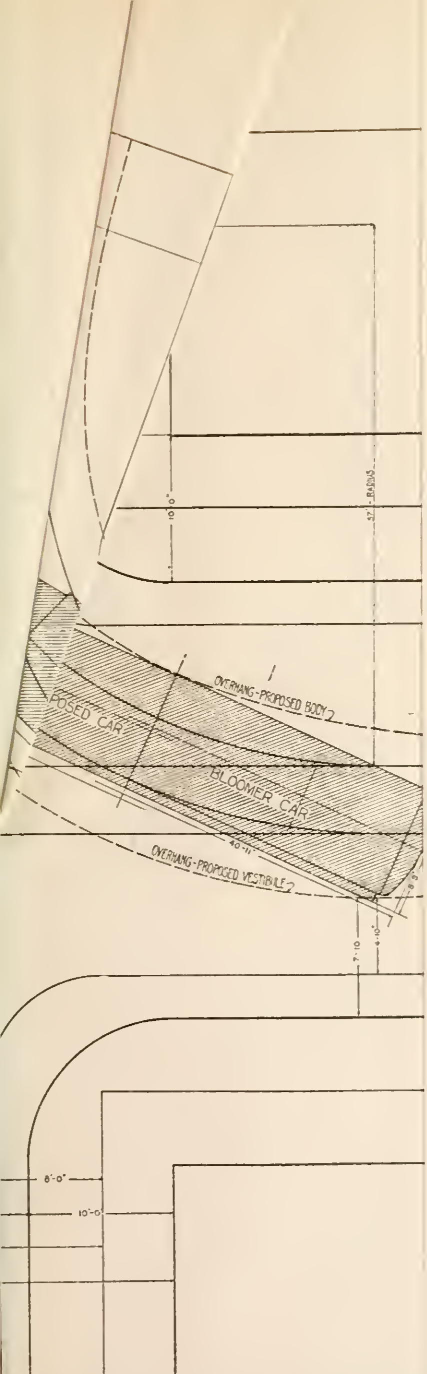


PLATE IX—CAR CLEARANCE—I
erhang of car when rounding a connec
streets, i. e., for corresponding 24-ft. and
he present bloomer car. Note that a 50

IX

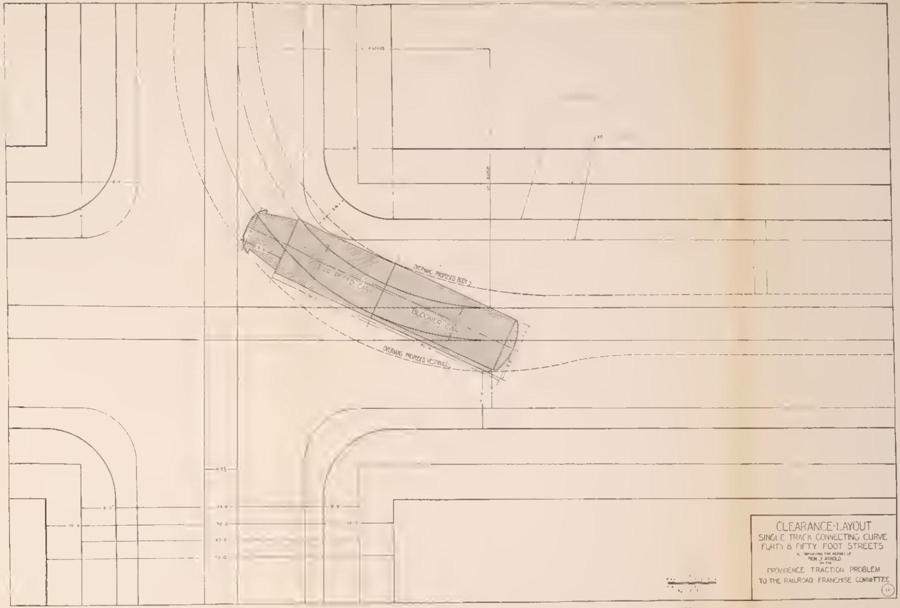


PLATE IX—CAR CLEARANCE—DIAGRAM FOR SINGLE TRACK.

Showing the limiting curves of maximum overhang of car when rounding a connecting curve between intersecting single tracks. The street clearance is shown by dotted lines for both 40-foot and 50-foot streets, i. e., for corresponding 24-ft. and 30-ft. roadways. A composite car body is used in order to show that the overhang of the proposed vestibule is less than the present bloomer car. Note that a 50-ft. street gives ample clearance on curves for a vehicle 7 ft. in width and no curb overhang.

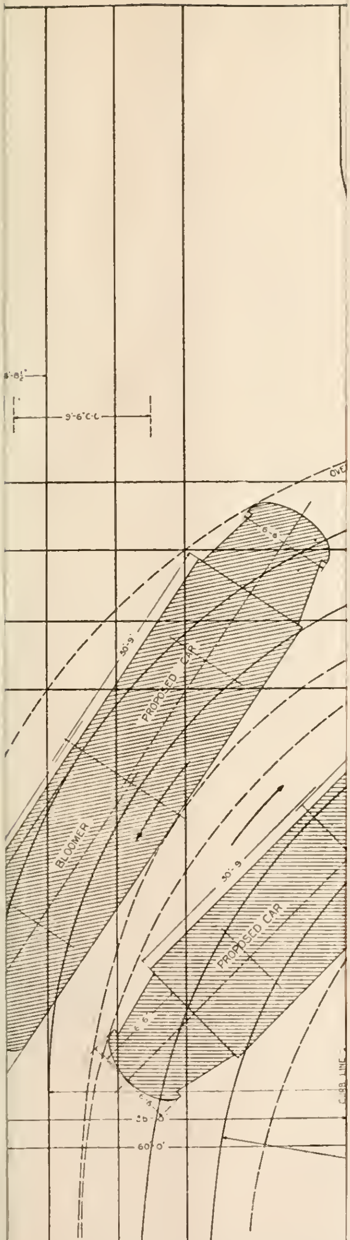


PLATE X—CAR CLEARAN
for a 60-ft. street (36-ft. roadwa
rms. By means of a short tange
no smaller than for the present
m.

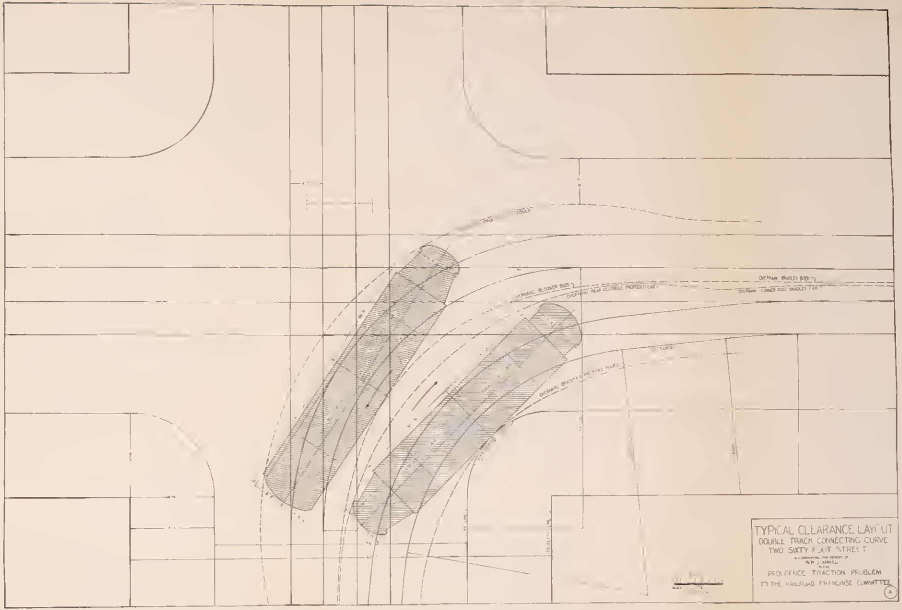


PLATE X—CAR CLEARANCE DIAGRAM FOR DOUBLE TRACK.

This diagram is similar to Plate XI, except for a 60-ft. street (36-ft. roadway) with two intersecting curves. The composite templates show both Bradley and bloomer cars as compared with proposed platforms. By means of a short tangent on the connecting curves, cars are enabled to pass on curves, overhang at curbs is avoided, and the clearance for vehicles is no smaller than for the present equipment. Note the necessity of wide vehicles stopping back of the street corner to avoid being crushed by the rear car platform.

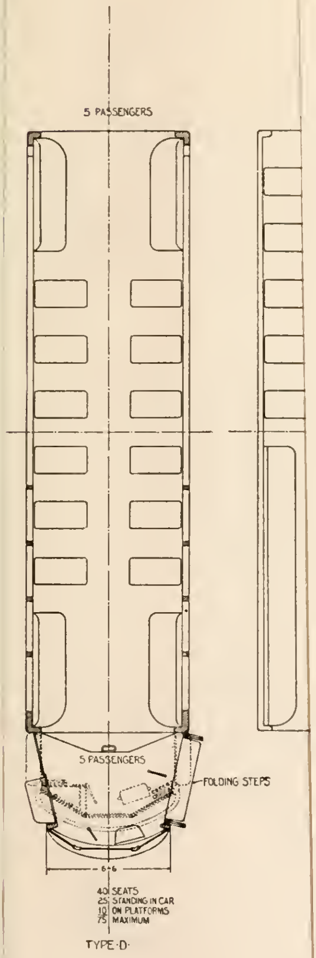


PLATE XI—STUDIES
repaying cars, also proposed
inches apart. Types "B", "C
enlarged for prepayment.
eads removed, folding doors

XI

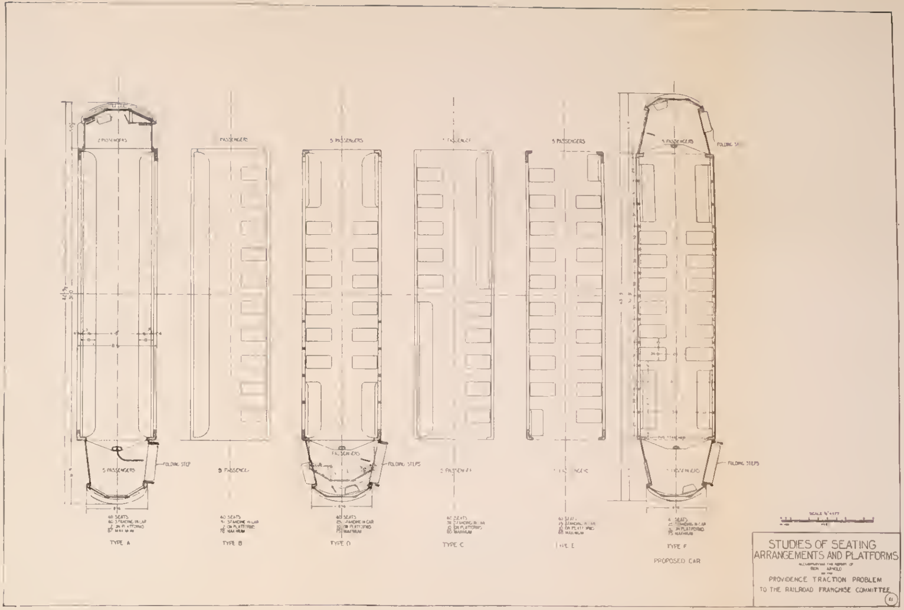


PLATE XI—STUDIES OF PLATFORM AND SEATING ARRANGEMENT.

Showing six different arrangements for prepaying cars, also proposed and present Bradley platform. Type "F" represents the proposed Providence car for new equipment, having cross seats spaced 20 inches apart. Types "B", "C", "D", "E" show the present Bradley body with cross seats spaced 32". Type "A" shows the present car with rear platform only enlarged for prepayment. Types "A" and "B" are suitable only for singe ended operation, all other for either single or double operations. All types have bulkheads removed, folding doors and lift steps. Principal exit forward and conductor at the rear using fare collector.

XII

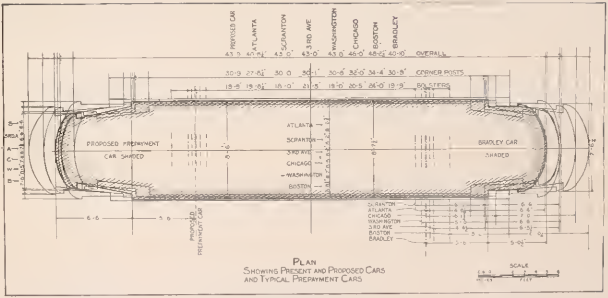


PLATE XII—COMPOSITE CAR PLANS.

In the diagram the prepayment car proposed for Providence and the present Bradley car now in use are superimposed in outline upon plans of typical prepayment cars used in other cities.

XIII

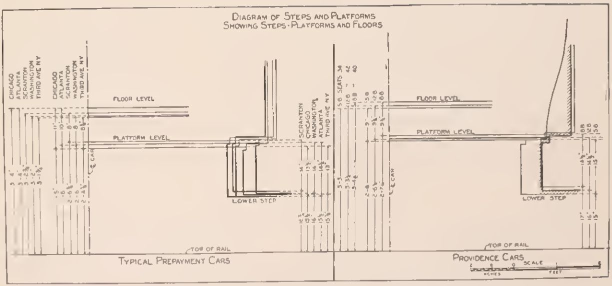


PLATE XIII—COMPOSITE STEP ELEVATIONS.

Sectional elevations showing platform floor and step levels of the three principal types of Providence cars as compared with similar cars used in other cities. The proposed car is evidently not of excessive dimensions and the step heights do not differ widely from other cars.

XIV

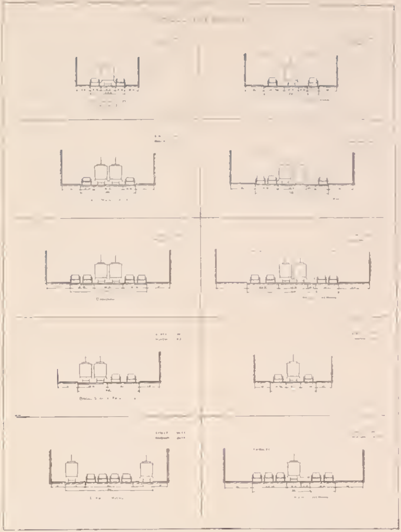
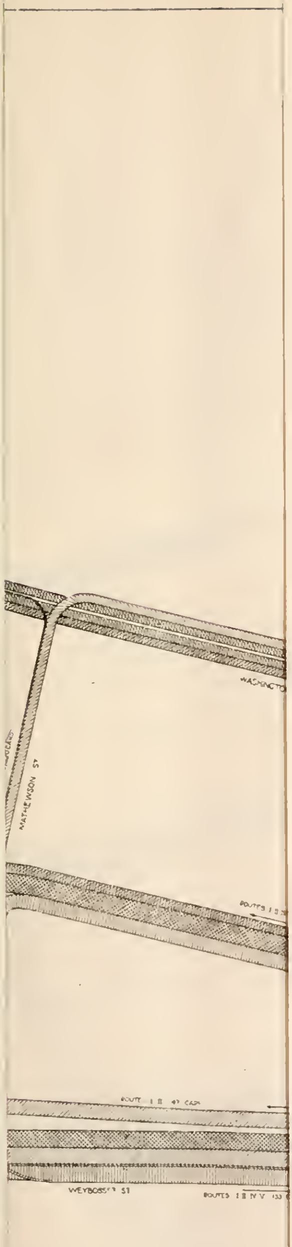


PLATE XIV—VEHICLE CLEARANCE DIAGRAM.

Showing cross sections of typical Providence roadways also the requisite dimensions for accommodating various lines of traffic, both along straight or tangent track, and on curves. An average vehicle width of 7 ft. is assumed. A 50 ft. street will only accommodate comfortably single track and a 60 ft street double track.



V—CAR FLOW MAP, T
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XV

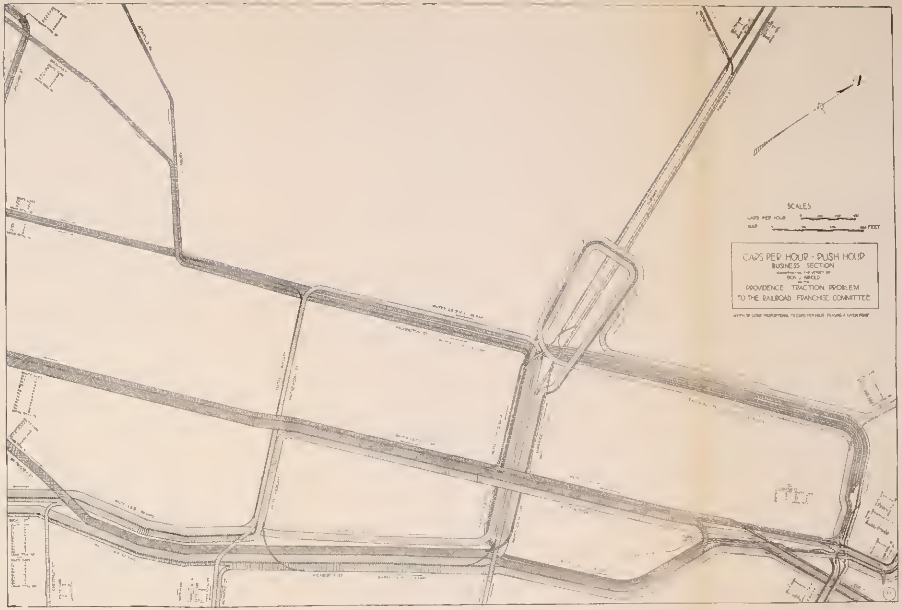


PLATE XV—CAR FLOW MAP, TERMINAL DISTRICT, DURING RUSH HOURS.

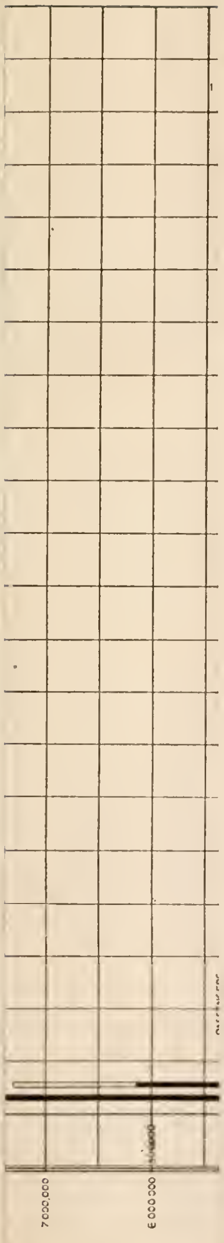
Indicating the relative movement of street cars through the various thoroughfares of the loading district. The width of the bands is proportional to cars per hour passing. Arrows indicate the direction of running. Subdivisions of the flow were determined by grouping various car lines that follow the same routing through the business center. These groups are detailed along the margin by route numbers corresponding to the winter schedule. The actual number of cars passing per hour is given along each street. Car interferences at street intersections are indicated by the crossing of these belts.

THAYER ST
0.53
0.27
0.73
0.73
ANGELL ST
1.04
WATERMAN ST
1.04
BROWN ST
0.46
0.23
1.27
1.27
0.11
0.11
1.10
1.50
0.50
0.29
0.24
RANCIS ST
PROMENADE ST
0.33

XVI

PLATE XVI.—RELATIVE STREET CONGESTION, CARS PER FOOT WIDTH OF ROADWAY PER HOUR.

Illustrating graphically the great difference in car traffic along various thoroughfares as compared to the available width of roadway. This diagram is similar to Plate XV. except that the car flow is reduced to a basis of equal width of roadway Compare for example Westminster Street and Broadway or Francis Street. This diagram simply emphasizes the very unequal distribution of cars over the downtown streets.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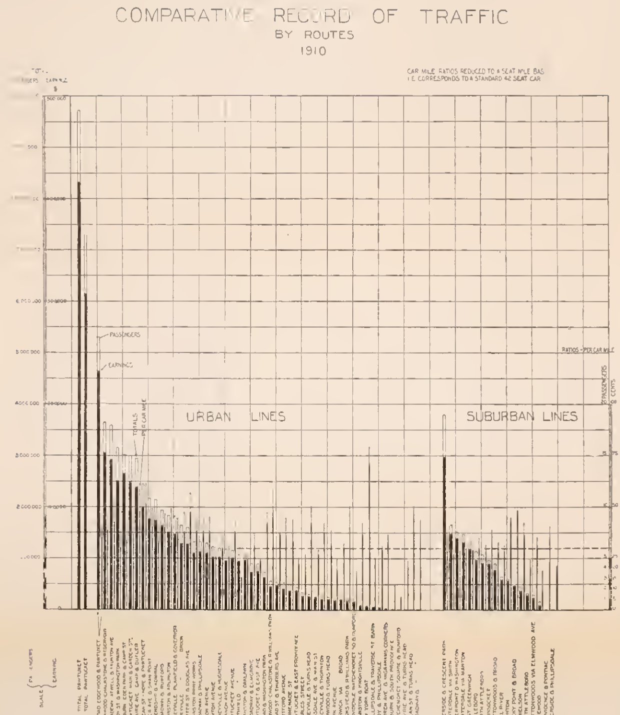
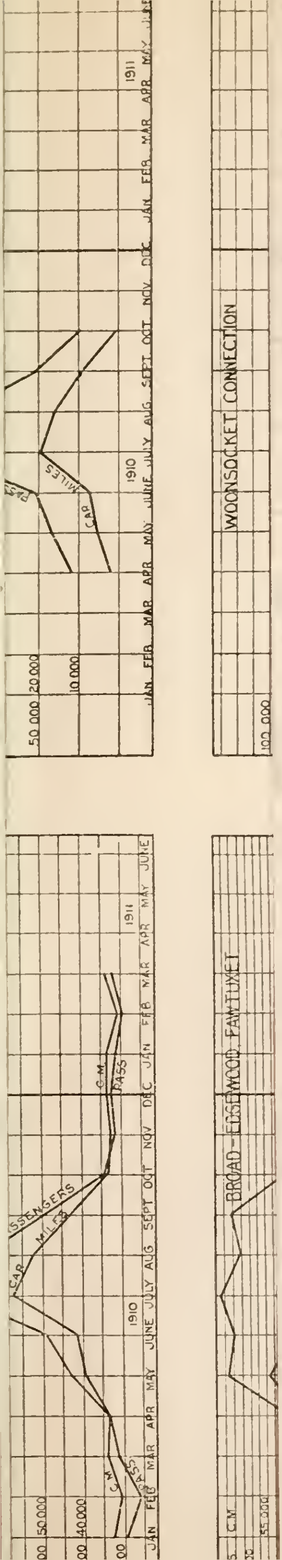


PLATE XVII—RECORD OF COMPARATIVE TRAFFIC AND EARNINGS BY ROUTES—1910.

Presenting a graphical comparison of the total passengers and earnings of individual routes for the year. Pawtucket and Pawtuxet traffic has been grouped for convenient comparison. It will be noted that the Edgewood and Pawtuxet traffic is the heaviest of any single route and Riverside, Crescent Park the next heaviest. Transfer business is indicated by the open spaces, i. e., difference in height between passengers and earnings, the scales having been chosen for this purpose. This diagram also shows by means of the light lines the total passengers and earnings per standard car mile, i. e., actual car mile ratios have been reduced to a set mile basis, assuming the standard car of 42 seats. Dotted lines indicate 30 c. per car mile, which has been used as a basis of computing service. Nearly all of the through routes and most of the suburbans earn over 30 c. per standard car mile.


WOONSOCKET CONNECTION
BROAD - EDGEWOOD - PAWTUXET
CAR MILES
PASSENGERS
C.M.
PASS
1910
1911
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
50 000
40 000
20 000
10 000
100 000
55 000

XVIII

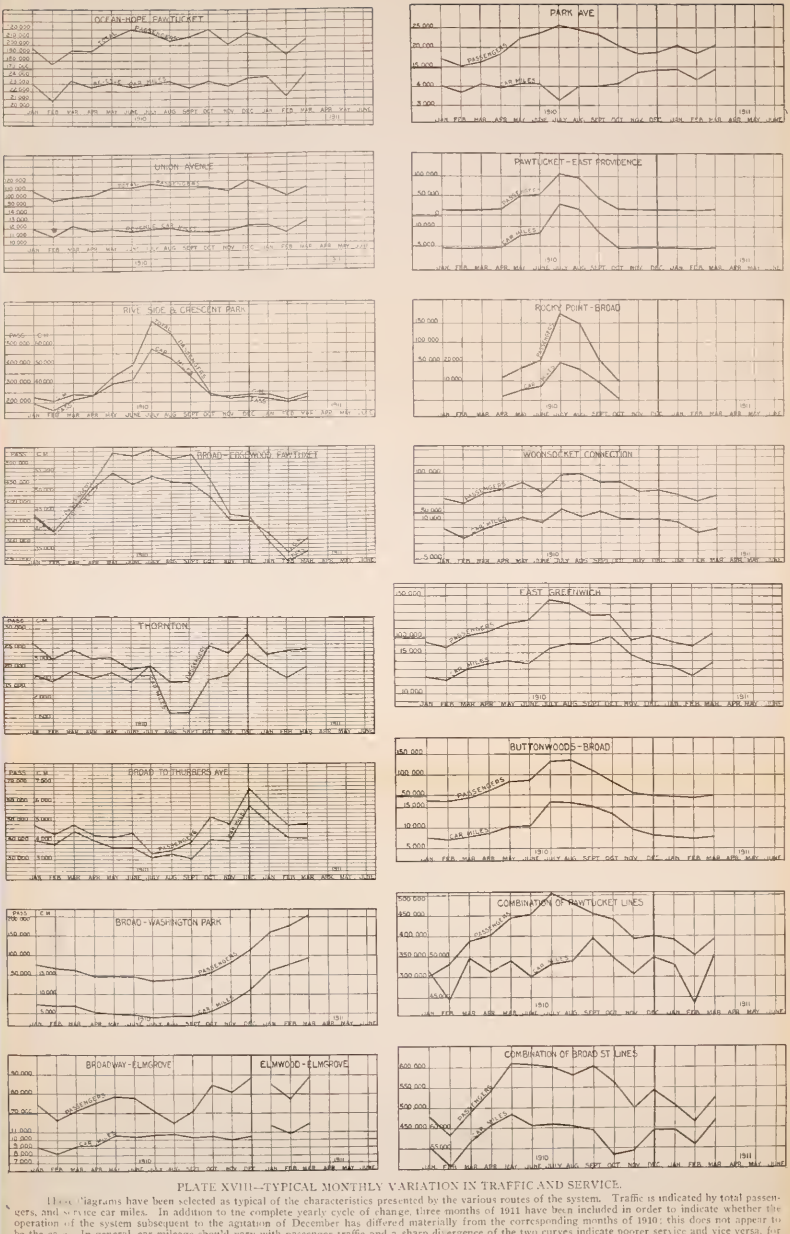
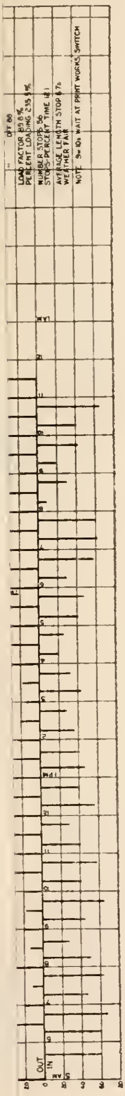


PLATE XVIII—TYPICAL MONTHLY VARIATION IN TRAFFIC AND SERVICE.

These diagrams have been selected as typical of the characteristics presented by the various routes of the system. Traffic is indicated by total passengers, and service car miles. In addition to the complete yearly cycle of change, three months of 1911 have been included in order to indicate whether the operation of the system subsequent to the agitation of December has differed materially from the corresponding months of 1910; this does not appear to be the case. In general, car mileage should vary with passenger traffic and a sharp divergence of the two curves indicate poorer service and vice versa, for example Broad-Washington Park as compared with Park Avenue. However, the additional seating capacity of the open cars makes somewhat less car mileage necessary during the summer, but sharp changes from month to month are clearly a measure of service. The Company appears to have followed traffic variations very closely throughout these seasonal changes, but in some instances have retrenched too much in car mileage, for example,—on the Pawtucket lines. Note that the change from Broadway-Elmgrove to Elmwood-Elmgrove has resulted in increased traffic.



Ξ XIX, A—TYPIC/
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XIX-A

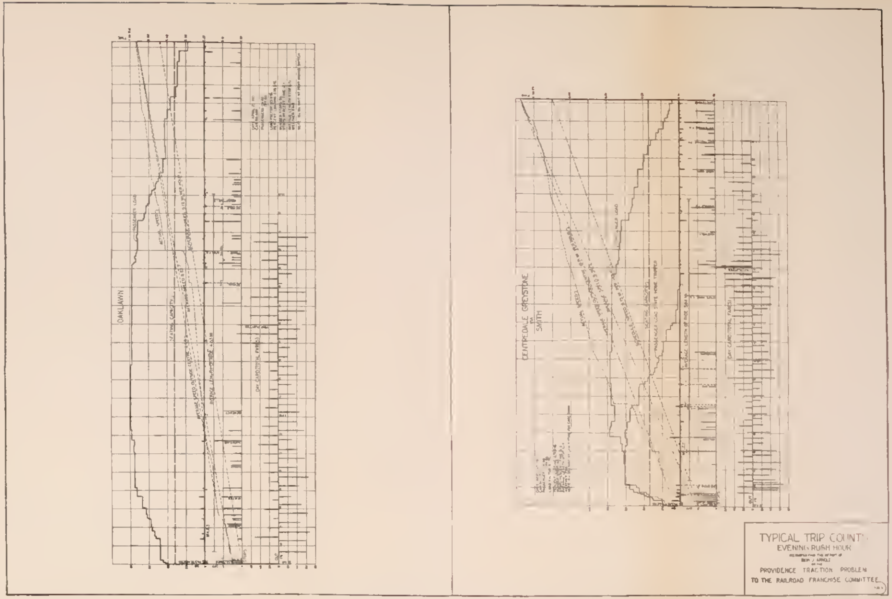
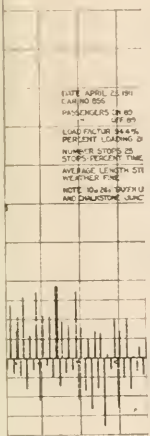


PLATE XIX, A—TYPICAL PASSENGER COUNTS BY INDIVIDUAL ROUTE TRIPS.

Complete graphical record of speed, time of stops, passengers entering and alighting, passenger load, delays, and the average length of ride during rush hours. These loading curves indicate the peculiar loading characteristics of each route and have been selected from 75 similar counts to illustrate various features discussed in the report. To determine whether these particular trips are representative, the trip cards reported by conductors for the entire day have been appended, indicating general variation in traffic and frequency of service. These day trip cards are plotted from schedule running time, not from actual time run, so that the headway appears regular.

Oaklawn. Typical long haul local run. Standing 6½ miles. Loading 235%. Most of the standing load drops off at Knightsville. Delays 9 minutes and 10 seconds at Print Works. Speed below schedule. Trip representative of the three rush hour trips.

Centerdale via Smith Street. Another long haul route. Standing for 5 miles. Delays 4½ minutes at Smith Street turnouts. Speed much below schedule. Loading not maximum. Short haul tripper load curve superimposed upon long haul curve to indicate how long haul routes should be relieved.



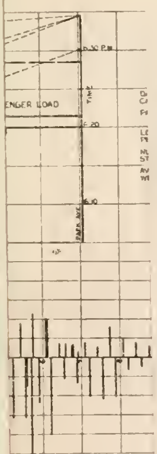


PLATE XIX
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XIX-B

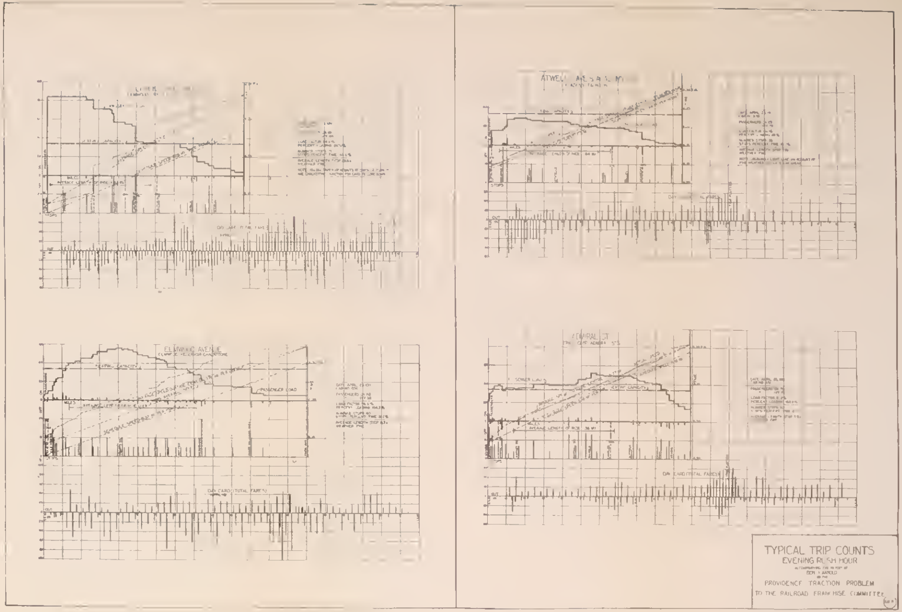

PLATE XIX-B—TYPICAL, ETC. SAME AS ON PLATE XIX

Chalkstone Ave. A short haul but heavily loaded line route. 10½ minutes delay at turnouts. Speed far below schedule, requiring nearly thirty minutes to run a distance of 2 2-3 miles. Note that standing load disappears at Davis Park, which suggests short haul trippers. Loading not much higher than normal at rush hours.

Elmwood Ave. A rather light trip. Speed somewhat below schedule. Inbound evening rush hour trips appear to be the heaviest on this line.

Academy Ave. An example of a very light trip just after 6 P. M. between a number of heavy trips, due to late car ahead. Car practically on time. Rush hour loading on this line heavy both morning and night.

Admiral Street. This line picks up a double load from Randall Square north. Note the tendency of the load to remain to the end of the trip. This indicates that the Admiral Street route should be extended for some distance, presumably to Branch Avenue.

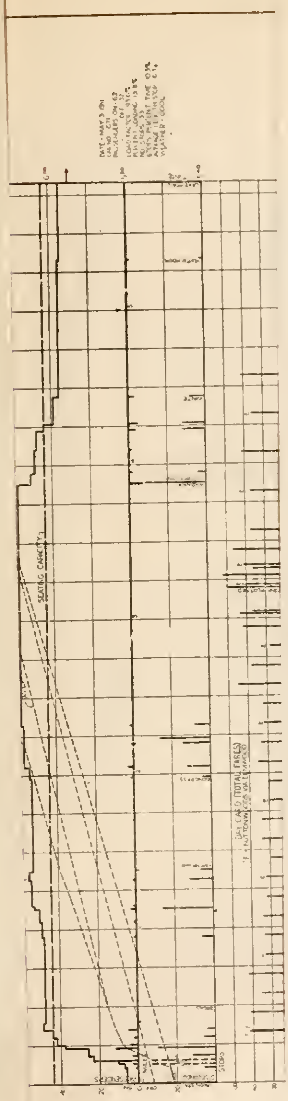

PLATE XIX-C—TYI
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XIX-C

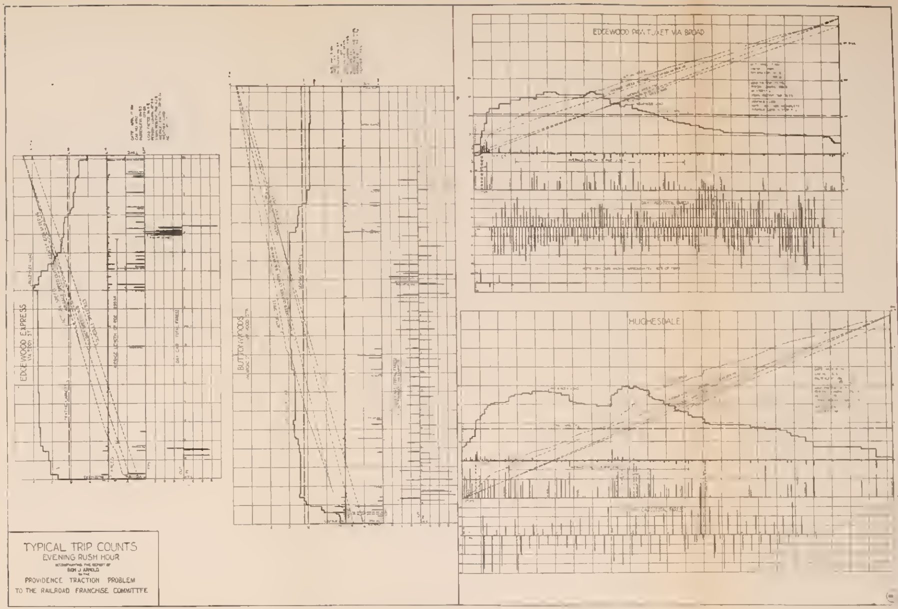


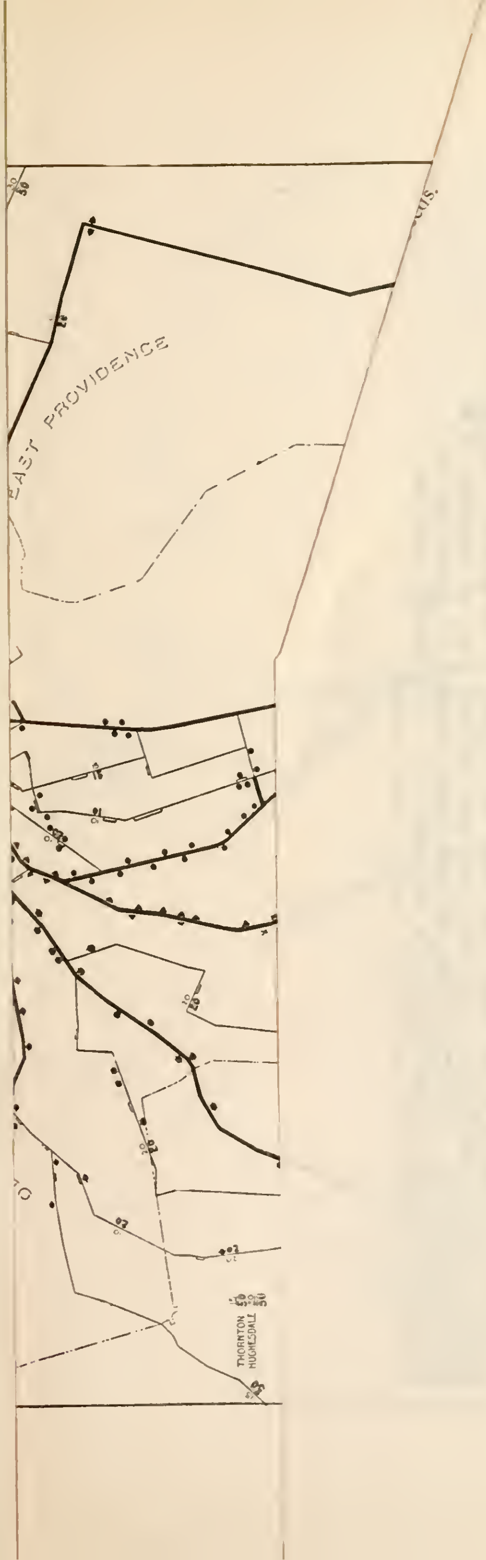
PLATE XIX-C—TYPICAL ETC., SAME AS PLATE XIX.

Edgewood Express. Typical short haul express route, making good time and eliminating the delays and congestion of local loading.

Buttonwoods via Broad. Typical suburban express route. Note that practically all of the load originates within the terminal loading districts. The average ride was not obtained, as the count was carried only as far as Lakewood. On the day cards the Buttonwoods via Elmwood trips were also shown

Edgewood-Pawtuxet. Typical curve of the heaviest line of traffic in the city. Represents a very fair standard of loading. Standing—57% continued for 2½ miles. Speed somewhat below schedule. Day card incomplete, but sufficient trips are plotted to indicate the extremely heavy traffic encountered on this line.

Hughesdale. An example of long haul local route, forced to carry local traffic. Standing for 4½ miles. This curve shows plainly the double loading occurring at Olneyville. This results in a load factor of only 77%, i. e., maximum passengers aboard representing only 77% of the total fares registered on the trip, due to double loading. Speed below schedule.



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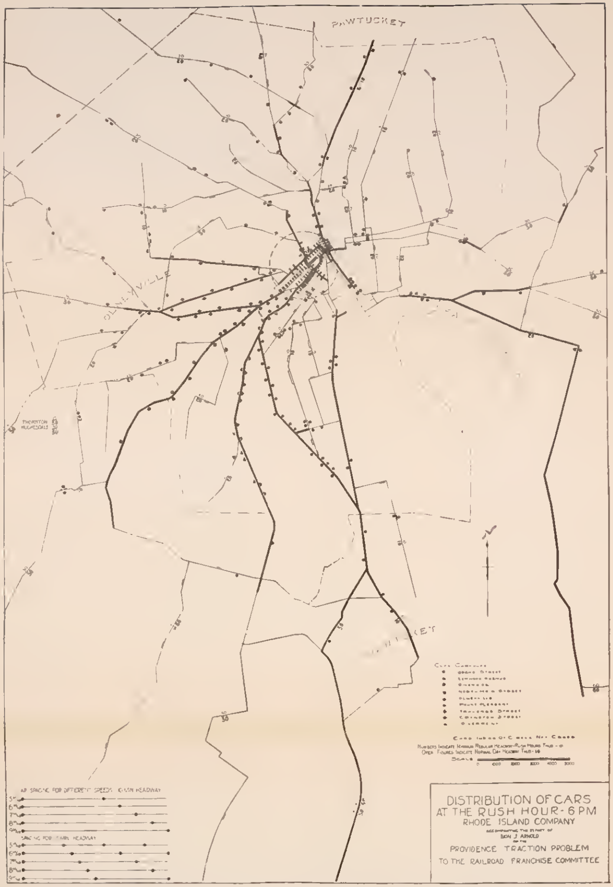
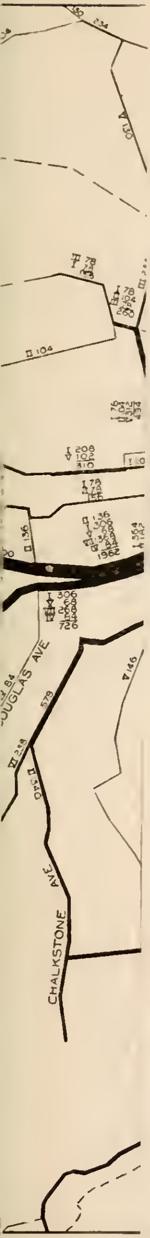


PLATE XX—DISTRIBUTION OF CARS AND HEADWAY.

Black dots indicate the schedule position of cars throughout the system at 6 P. M., winter schedule, these cars being coded according to the car house from which they originate. The excessive congestion within the business district is apparent and the heavy car traffic down town evidently gives no indication of the car distribution on various radiating lines. Numbers indicate minimum regular headway for normal and for rush hours. Headway along combined route thoroughfares may be estimated by the supplementary scale for various running speeds. Note the prevalence of single track even for 5 and 10 minute headway.



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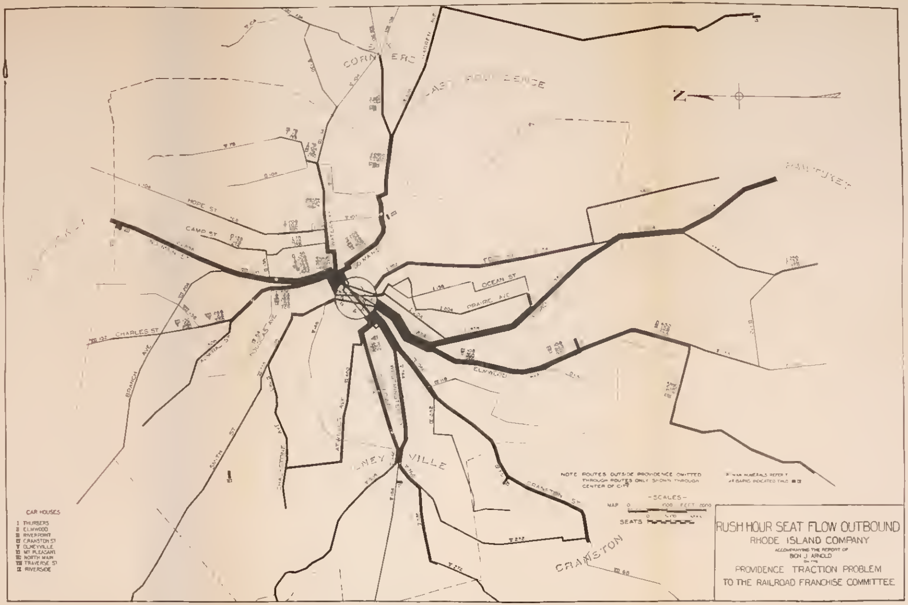

PLATE XXI—SEAT FLOW MAP OF SYSTEM—RUSH HOURS.

A graphical record of seats scheduled to pass various points on all lines during the rush hour. An exact idea of the relative amount of service on various routes may be had by comparing the width of the various lines, which is proportional to the seat flow. This map shows the nine outlet throats of traffic discussed in the report and also the relative importance of through routes, these only being shown within the down town circle.